9. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.

10. Loosen and remove the capscrews from drilled holes.

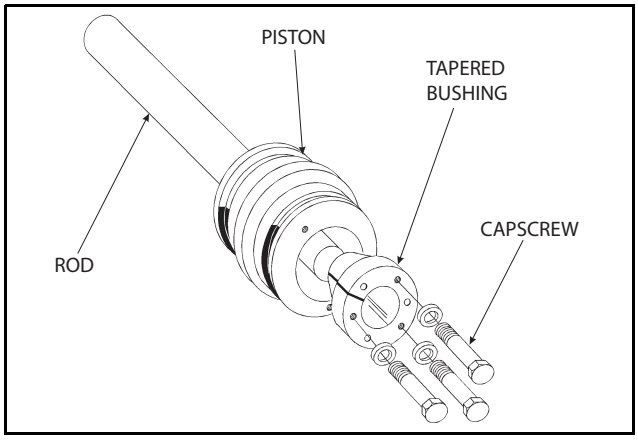



**Figure 5-79. Tapered Bushing Removal**

11. Insert the capscrews in the threaded holes in the outer-piece of the tapered bushing. Progressively tighten the-capscrews until the bushing is loosen from the piston

12. Remove the tapered bushing from the piston.

13. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.

14. Remove and discard the piston o-ring, backup rings, hydrolock seals, guidelock rings and wear ring.

15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-ring, backup rings, rod seal, wear ring and wiper seal.

## CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.

2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.

3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.

4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering orovality. Replace if necessary.

5. Inspect threaded portion of barrel for damage. Dress threads as necessary.

6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.

7. Inspect threaded portion of piston for damage. Dress threads as necessary.

8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.

9. Inspect cylinder head inside diameter for scoring, tapering, ovality or other damage. Replace as necessary.

10. Inspect threaded portion of head for damage. Dress threads as necessary.

11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.

12. Inspect cylinder head outside diameter for scoring, tapering, ovality or other damage. Replace as necessary.

13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.

    **a.** Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.

    **b.** Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.

    **c.** Lubricate inner side of the steel bushing prior to bearing installation.

    **d.** Using an arbor of the correct size, carefully press the bearing into steel bushing.

***NOTE:*** *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

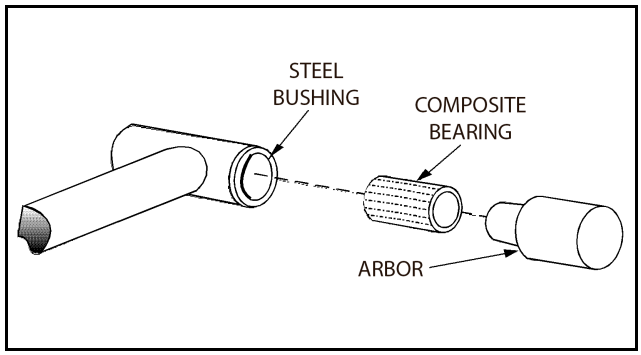



**Figure 5-80. Composite Bearing Instal-**

**14.** Inspect port block fittings and holding valve. Replace as necessary.

**15.** Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.

**16.** Inspect piston rings for cracks or other damage. Replace as necessary.

## ASSEMBLY

***NOTE:*** *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

***NOTE:*** *Apply a light film of hydraulic oil to all components prior to assembly.*

**1.** A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

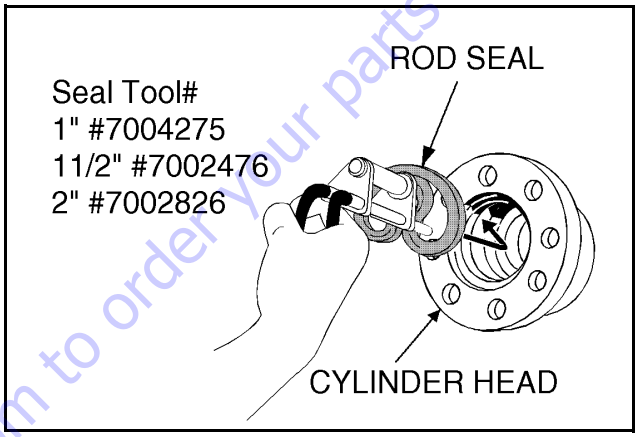



**Figure 5-81. Rod Seal Installation**

***NOTICE***

**WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPERCYLINDER OPERATION.**

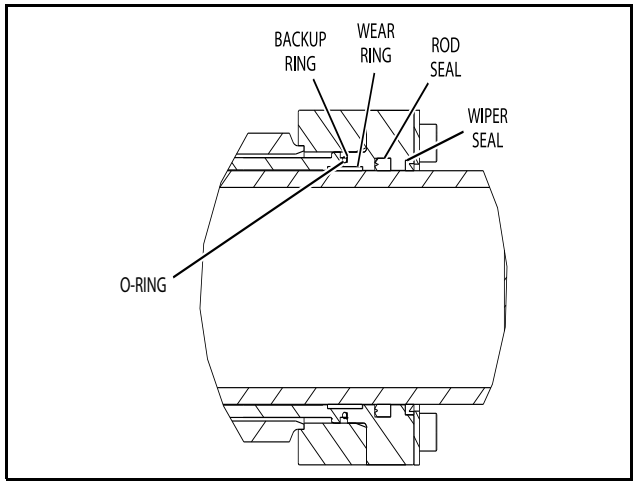



**Figure 5-82. Cylinder Head Seal Installation**

2. Use a soft mallet to tap a new wiper seal into the cylinder head gland groove. Install a new wear ring into the cylinder head gland groove.

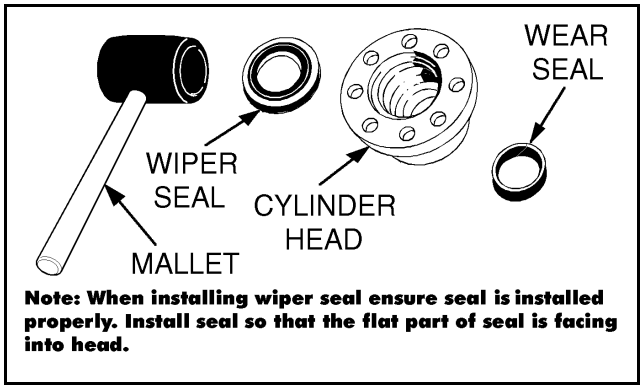



**Figure 5-83. Wiper Seal Installation**

3. Place a new o-ring and backup ring in the outside diameter groove of the cylinder head.

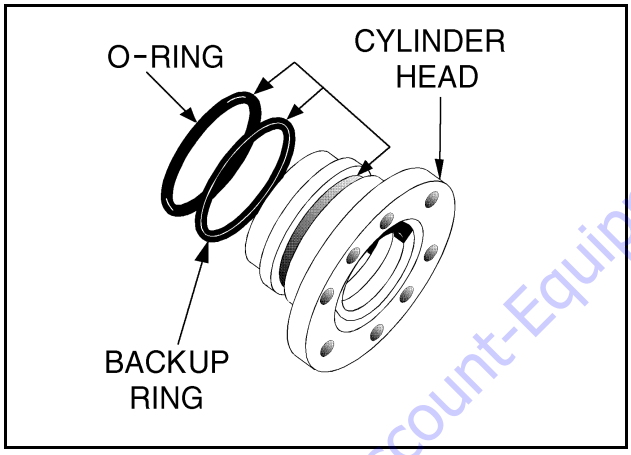



**Figure 5-84. Installation of Head Seal Kit**

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.

5. Place a new o-ring and backup rings in the inner piston diameter groove.

6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston threads as possible.

7. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

***NOTE:*** *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

8. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

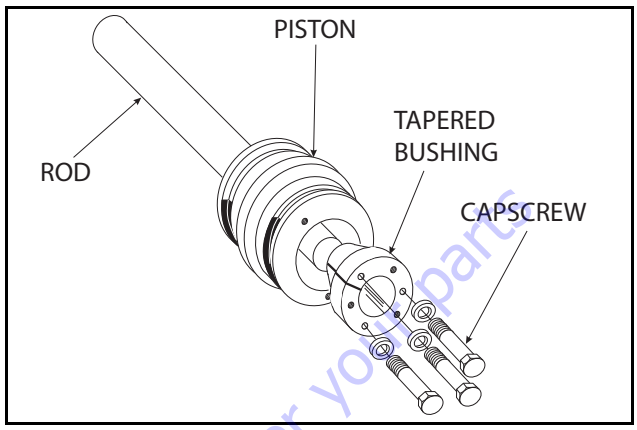



**Figure 5-85. Tapered Bushing Installation**

9. Tighten the capscrews evenly and progressively in rotation to 60 ft. lbs. (81 Nm).

10. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

    **a.** Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    **b.** Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

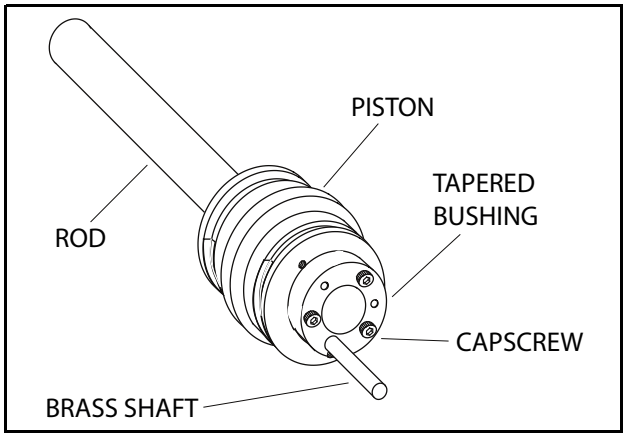



**Figure 5-86. Seating the Tapered Bearing**

11. Re-torque the capscrews evenly and progressively in rotation to 60 ft. lbs. (81 Nm).

12. Remove the cylinder rod from the holding fixture.

**NOTICE**

**WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.**

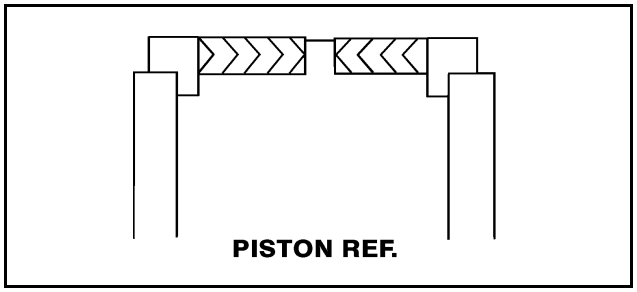



**Figure 5-87. Hydrolock Piston Seal Installation**

13. Place new hydrolock seals and guidelock rings in the outer piston diameter grooves. (A tube, with I.D. slightly larger than the O.D.of the piston is recommended to install the seal).

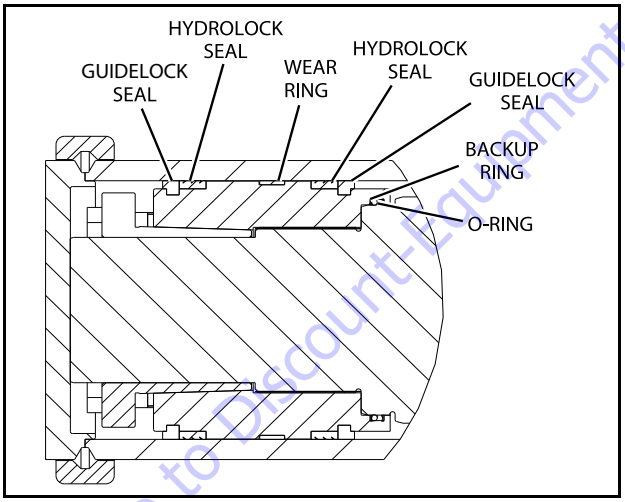



**Figure 5-88. Piston Seal Installation**

14. Position the cylinder barrel in a suitable holding fixture.

**NOTICE**

**EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.**

15. With barrel clamped securely, and adequately supporting the rod, insert the piston end into the barrel cylinder. ensuring that piston loading hydrolock seals and guidelock rings are not damaged or dislodged.

16. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

17. Apply Medium strength Threadlocking Compound to the socket head capscrews and secure the cylinder head gland using the washer ring and capscrews. Refer Figure 5-78. to torque bolts.

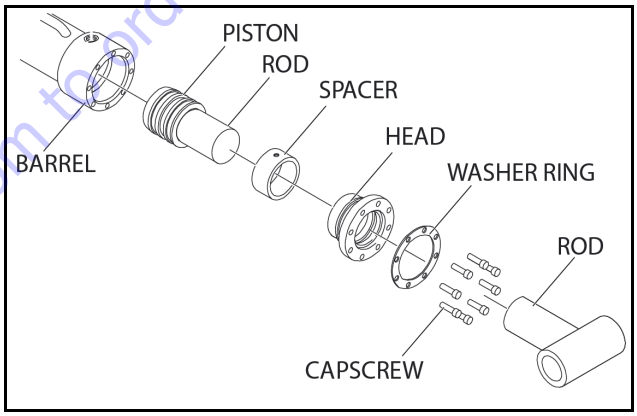



**Figure 5-89. Rod Assembly Installation**

18. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any valves.

19. Install the valve assembly. Torque capscrews refer to Figure 5-78.

20. Install the counterbalance valves in valve assembly. Torque 30-35 ft. lbs. (41-47 Nm).

21. Install the shuttle valve in valve assembly. Torque 20-25 ft. lbs. (27- 33 Nm).

22. Install the plug fittings in the valve assembly. Torque to plug fittings as per Figure 5-78.

## Steer Cylinder

### DISASSEMBLY

**NOTICE**

**DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.**

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

**NOTICE**

**DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.**

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Place the cylinder barrel into a suitable holding fixture.

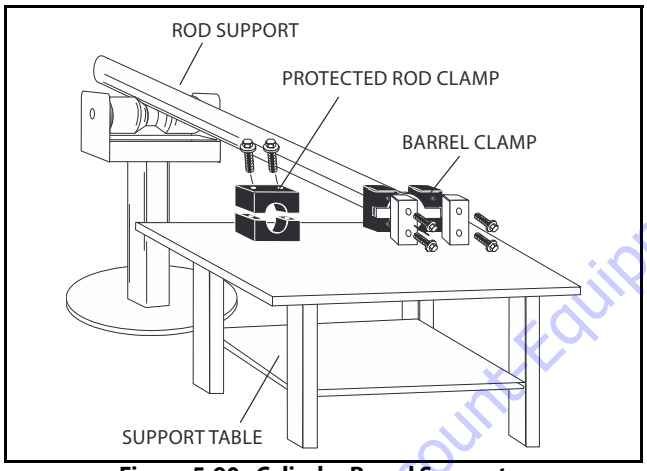



**Figure 5-90. Cylinder Barrel Support**

4. Mark cylinder head and barrel with a center punch for easy realignment. Using a pin-face spanner wrench, unscrew the cylinder head from the barrel., unscrew the cylinder head from the barrel.

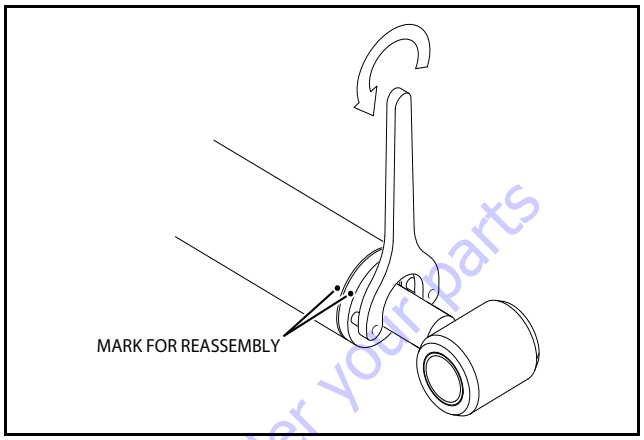



**Figure 5-91. Cylinder Cap Removal**

5. Attach a suitable pulling device to the cylinder rod end.

**NOTICE**

**EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THEROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.**

6. With the barrel clamped securely, apply pressure to the rod pulling device and carefully remove the complete rod assembly from the cylinder barrel.

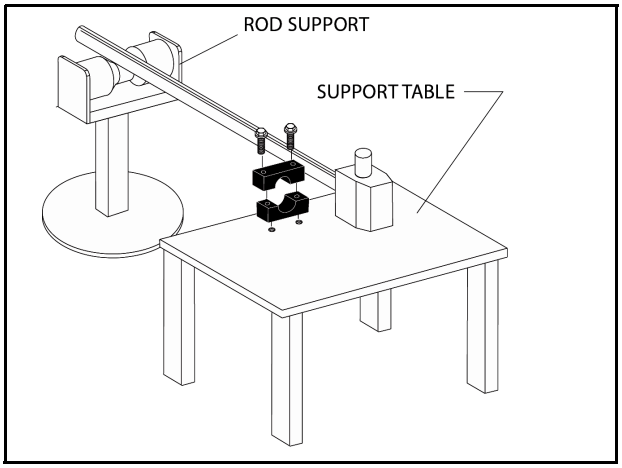
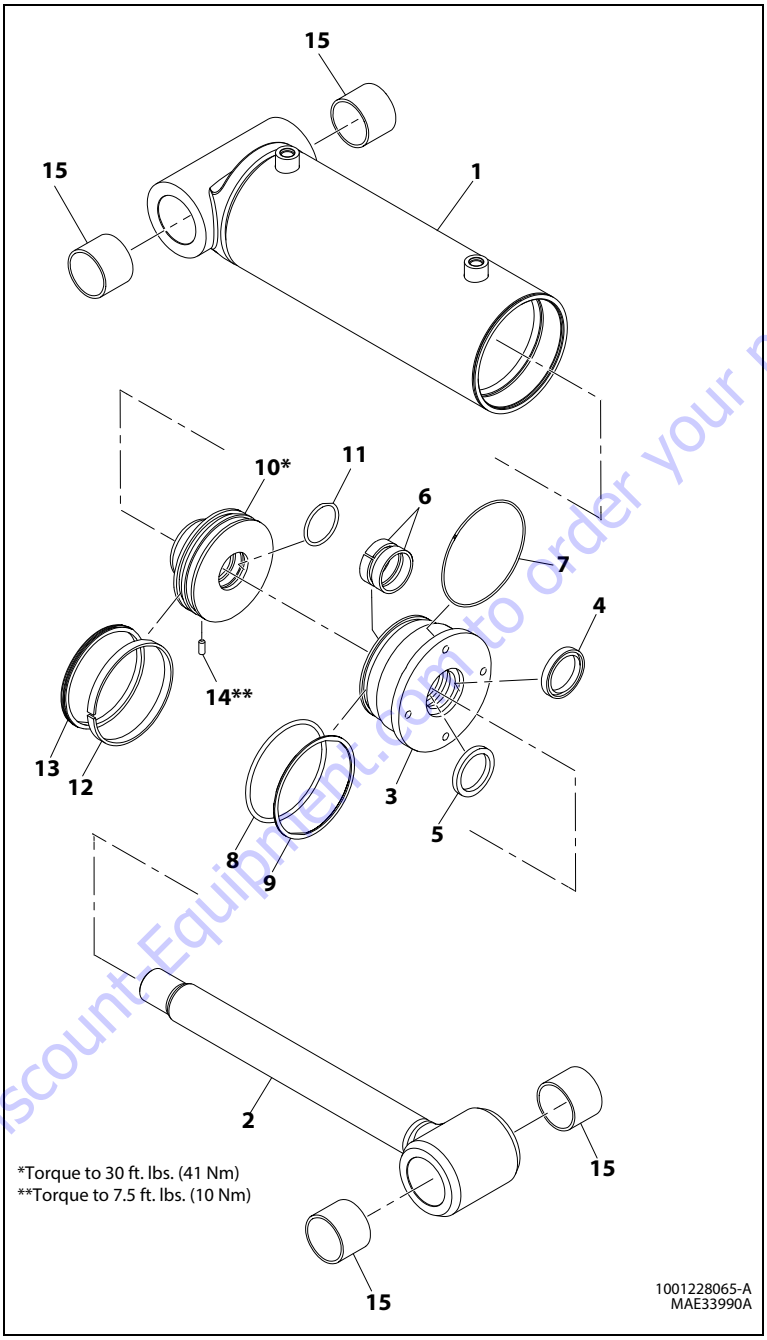



**Figure 5-92. Cylinder Rod Support**




1. Barrel
2. Rod
3. Head
4. Wiper Seal
5. Seal
6. Wear Ring
7. O-ring
8. O-ring
9. Backup Ring
10. Piston
11. O-ring
12. Wear Ring
13. Seal
14. Setscrew
15. Bushing

**Figure 5-93. Steer Cylinder**

7. Using suitable protection, clamp the cylinder rod in a vise or holding fixture as close to the piston as possible.

8. Loosen and remove the setscrew that secures the piston to the cylinder rod.

9. Remove the piston from the cylinder rod.

10. Remove and discard the o-ring, piston seal and wear ring.

11. Remove the rod from the holding fixture. Remove the cylinder head. Discard wear ring, o-ring, backup ring, wiper seal and rod seal.

## CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.

2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.

3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.

4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.

5. Inspect threaded portion of barrel for damage. Dress threads as necessary.

6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.

7. Inspect threaded portion of piston for damage. Dress threads as necessary.

8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.

9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.

10. Inspect threaded portion of head for damage. Dress threads as necessary.

11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.

12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.

13. Inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.

    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.

    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.

    c. Lubricate inside of the steel bushing prior to bearing installation.

    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

***NOTE:*** *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

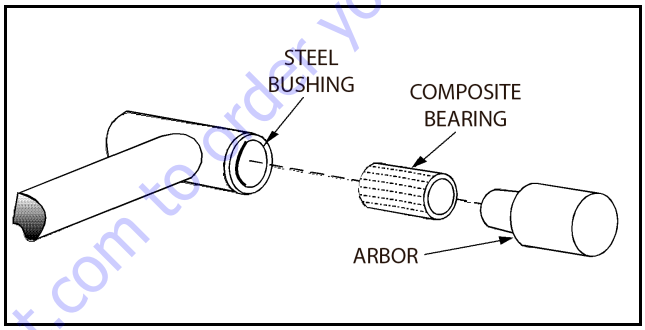



**Figure 5-94. Composite Bearing Installation**

14. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.

15. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

## ASSEMBLY

***NOTE:*** *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

***NOTE:*** *Apply a light film of hydraulic oil to all components prior to assembly.*

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

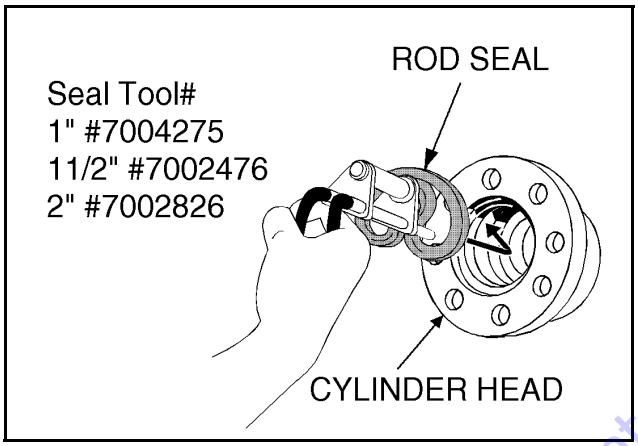



**Figure 5-95. Rod Seal Installation**

**NOTICE**

**WHEN INSTALLING NEW SEALS, ENSURE SEALS AREINSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.**

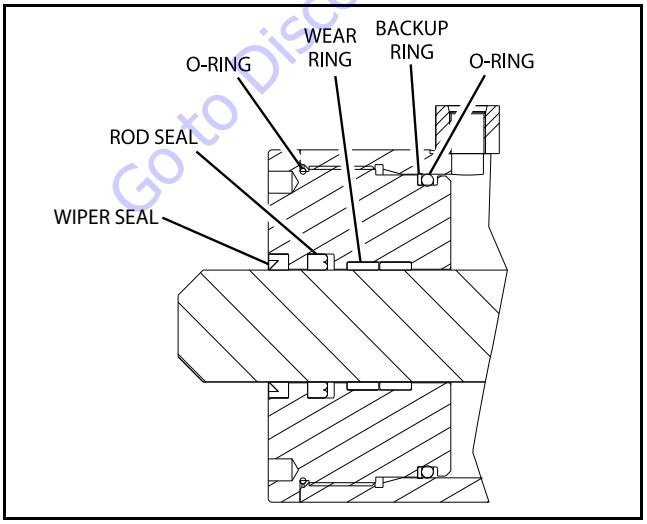



**Figure 5-96. Cylinder Head Seal Installation**

2. Use a soft mallet to tap a new wiper seal into the cylinder head gland groove. Install new wear rings and seal into the cylinder head gland groove.

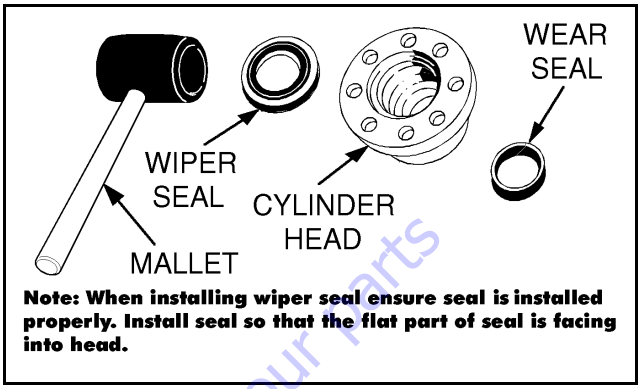



**Figure 5-97. Wiper Seal Installation**

3. Place a new o-rings and backup ring in the outside diameter groove of the cylinder head.

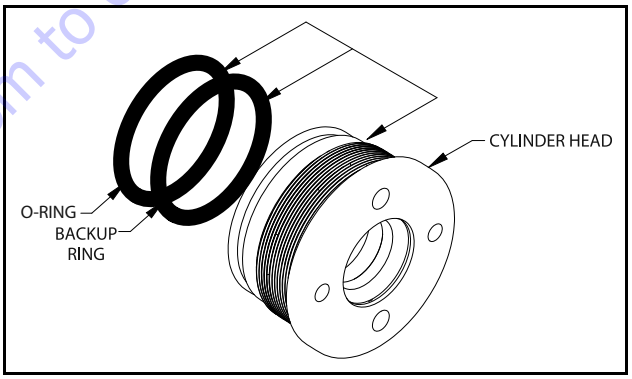



**Figure 5-98. Installation of Head Seal Kit**

4. Carefully install the head gland on the rod, ensuring that the wiper seal, wear rings and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.
5. Place a new o-ring n the inner piston diameter groove.
6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston threads as possible.
7. Carefully thread the piston on the cylinder rod, ensuring that the o-ring and backup rings are not damaged or dislodged. Torque to piston 30 ft. lbs. (41 Nm).
8. Carefully thread the setscrew onto the rod to secure the piston in place. Torque to 8 ft. lbs. (10 Nm).

9. Remove the cylinder rod from the holding fixture.

10. Place a new wear ring and piston seal in the outer piston diameter grooves. (A tube, with I.D. slightly larger than the O.D.of the piston is recommended to install the seal).

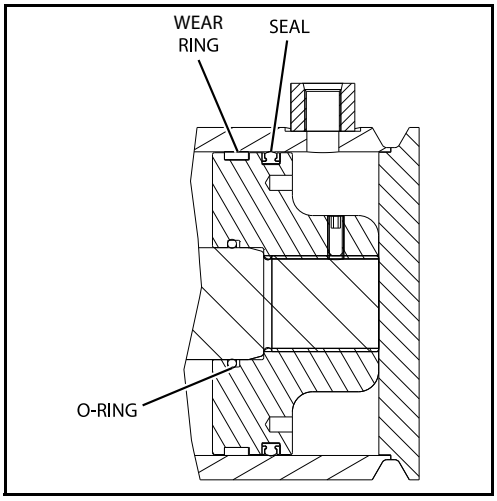



**Figure 5-99. Piston Seal Installation**

11. Position the cylinder barrel in a suitable holding fixture.

**NOTICE**

**EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.**

12. With barrel clamped securely, and adequately supporting the rod, insert the piston end into the barrel cylinder. ensuring that the piston loading wear ring and piston seal are not damaged or dislodged.

13. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

14. Apply anti-seized compound on cylinder head external thread and screw the cylinder head gland into the barrel using a pin-face spanner wrench. To torque gland refer Figure 5-93.

15. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted).

## Main Boom Telescope Cylinder

### DISASSEMBLY

**NOTICE**

**DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.**

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

**NOTICE**

**DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.**

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove the check valves, counterbalance valves, and relief valve from the cylinder port block. Discard o-rings.
4. Remove capscrew and remove valve assembly from cylinder rod end.
5. Place the cylinder barrel into a suitable holding fixture.

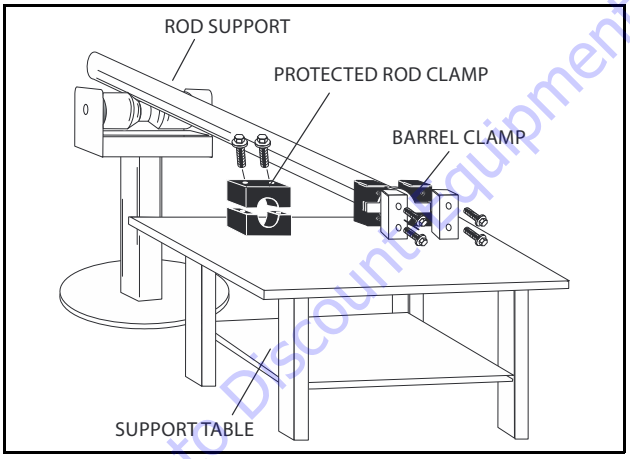



**Figure 5-100. Cylinder Barrel Support**

6. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer capscrews, and remove caspcrewa, washers and bracket from cylinder barrel.

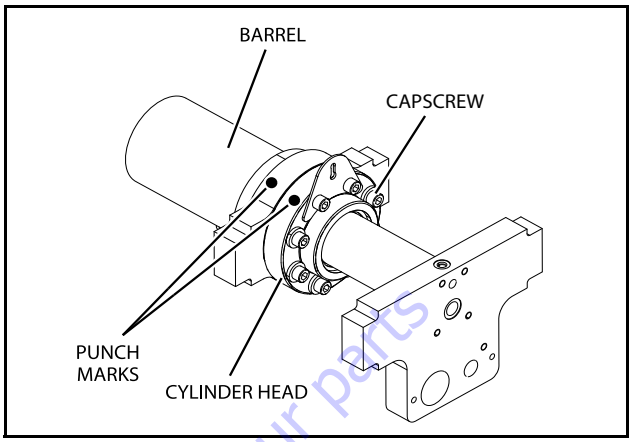



**Figure 5-101. Capscrew Removal**

7. Attach a suitable pulling device to the cylinder rod end.

**NOTICE**

**EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.**

8. With the barrel clamped securely, apply pressure to the rod pulling device and carefully remove the complete rod assembly from the cylinder barrel.

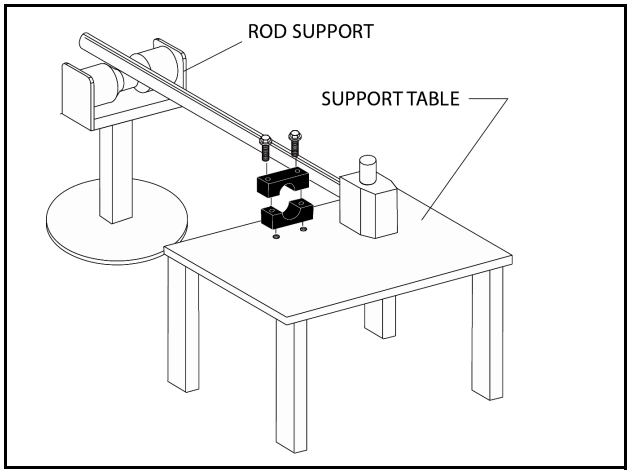
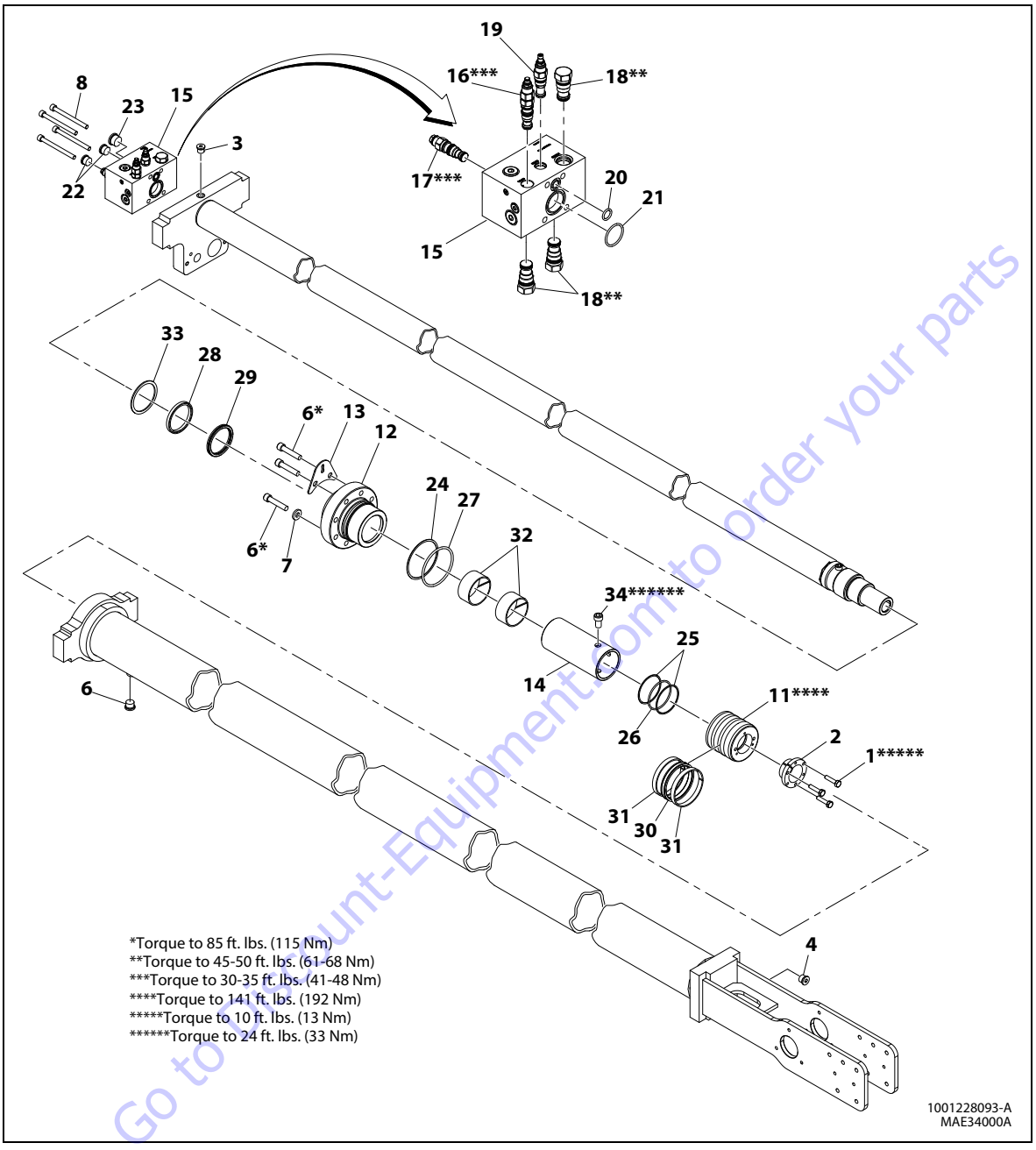



**Figure 5-102. Cylinder Rod Support**






1. Capscrew
2. Tapered Bushing
3. Plug
4. Plug
5. Capscrew
6. Capscrew
7. Washer
8. Capscrew
9. Barrel
10. Rod
11. Piston
12. Head
13. Bracket
14. Spacer Tube
15. Valve Assembly
16. Counterbalance Valve
17. Counterbalance Valve
18. Check Valve
19. Relief Valve
20. O-Ring
21. O-Ring
22. Plug
23. Plug
24. Backup Ring
25. Backup Ring
26. O-ring
27. O-ring
28. Wiper
29. Seal Rod
30. Piston Seal
31. Wear Ring
32. Wear Ring
33. Retaining Ring
34. Setscrew

**Figure 5-103. Main Boom Telescope Cylinder**

9. Using suitable protection, clamp the cylinder rod in a vise or holding fixture as close to the piston as possible.
10. Loosen and remove the capscrews from drilled holes.

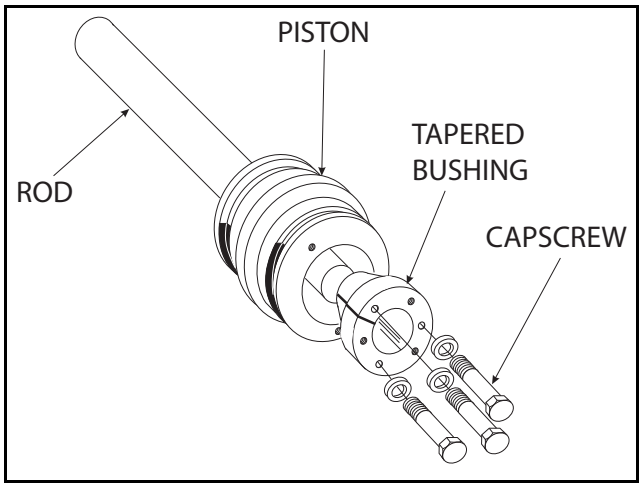



**Figure 5-104. Tapered Bushing Removal**

11. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen from the piston.
12. Remove the tapered bushing from the piston.
13. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
14. Remove and discard the piston seal, wear rings, o-ring and backup rings.
15. Loosen and remove capscrew from spacer, remove spacer from cylinder rod.
16. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-ring, backup ring, rod seal, wear rings, wiper seal and retaining ring.

## CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary
12. Inspect cylinder head outside diameter for scoring, tapering, ovality or other damage. Replace as necessary.
13. Inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inner side of the steel bushing prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.
14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent
15. If applicable, inspect port block fittings and holding valve. Replace as necessary.
16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.

17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

### ASSEMBLY

***NOTE:*** *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

***NOTE:*** *Apply a light film of hydraulic oil to all components prior to assembly.*

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

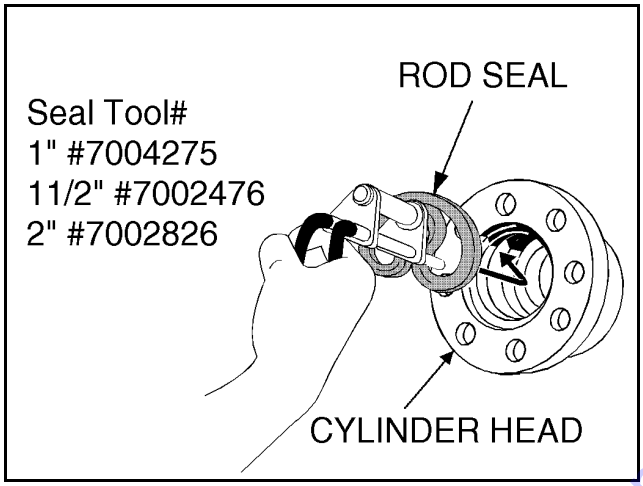



**Figure 5-105. Rod Seal Installation**

**NOTICE**

**WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.**

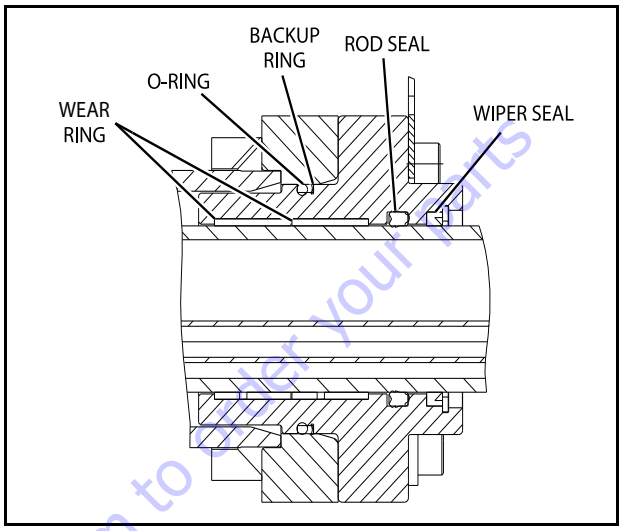
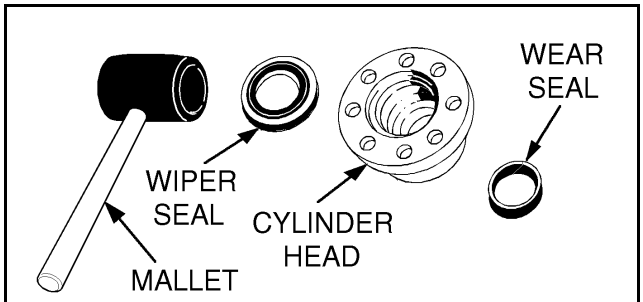



**Figure 5-106. Cylinder Head Seal Installation**

2. Use a soft mallet to tap a new wiper seal into the cylinder head gland groove. Install a new wear ring into the cylinder head gland groove.




**Note: When installing wiper seal ensure seal is installed properly. Install seal so that the flat part of seal is facing into head.**

**Figure 5-107. Wiper Seal Installation**

3. Place a new o-ring and backup ring in the outside diameter groove of the cylinder head.

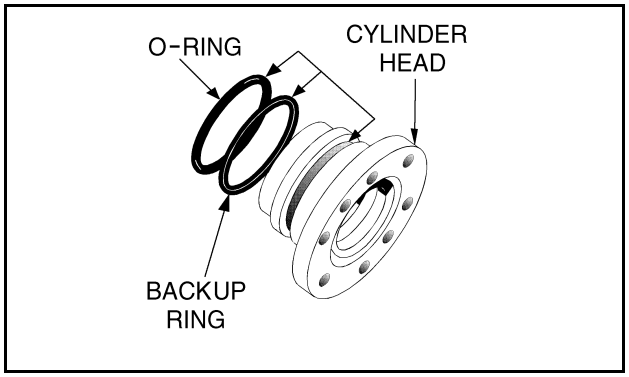



**Figure 5-108. Installation of Head Seal Kit**

4. Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.

5. Carefully slide the piston spacer onto the cylinder rod. Insert and tighten capscrew into spacer.

6. Place a new o-ring and backup rings in the inner piston diameter groove.

7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.

8. Carefully thread the piston on the cylinder rod hand tight ensuring that the o-ring and backup rings are not damaged or dislodged.

***NOTE:*** *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

9. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

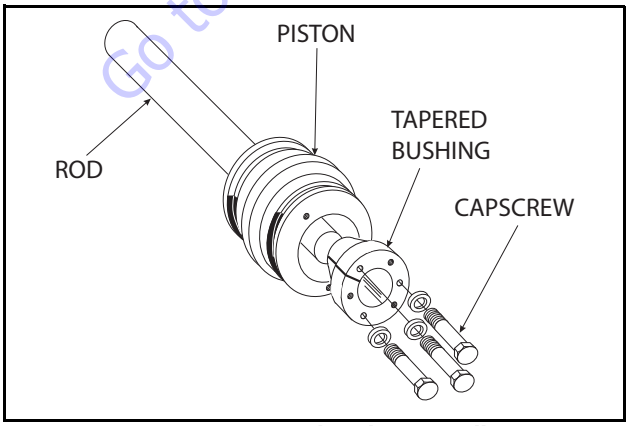



**Figure 5-109. Tapered Bushing Installation**

10. Tighten the capscrews evenly and progressively in rotation refer to Figure 5-103. and Figure 5-103.

11. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

    **a.** Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    **b.** Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

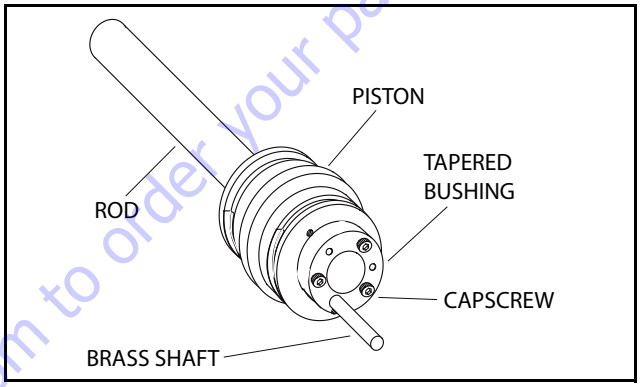



**Figure 5-110. Seating the Tapered Bearing**

12. Re-torque the capscrews evenly and progressively in rotation refer to Figure 5-103. and Figure 5-103.

13. Remove the cylinder rod from the holding fixture.

**14.** Place a new piston seal and wear rings in the outer piston diameter grooves. (A tube, with I.D. slightly larger than the O.D.of the piston is recommended to install the seal).

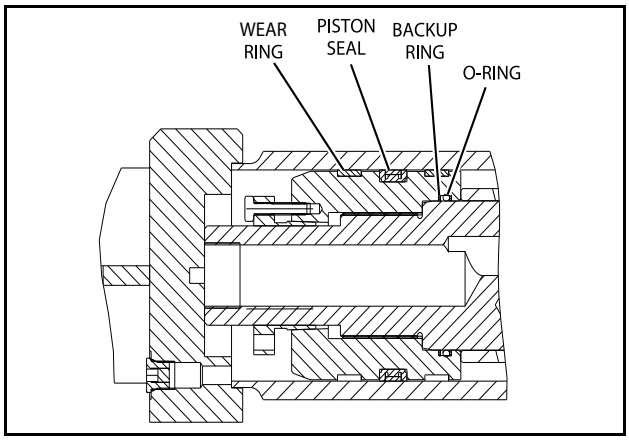



**Figure 5-111. Piston Seal Installation**

**15.** Position the cylinder barrel in a suitable holding fixture.

**NOTICE**

**EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.**

**16.** With barrel clamped securely, and adequately supporting the rod, insert the piston end into the barrel cylinder. ensuring that the piston seal wear rings are not damaged or dislodged.

**17.** Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

**18.** Apply Medium strength Threadlocking Compound to the socket head capscrew. Secure the cylinder head gland using the bracket, washers and capscrews. Torque capscrews to 85 ft. lbs. (115 Nm).

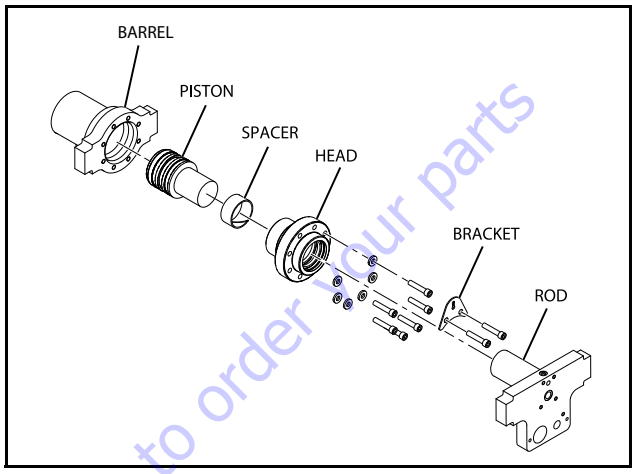



**Figure 5-112. Rod Assembly Installation**

**19.** After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any valves.

**20.** Install the valve assembly. Torque capscrews refer to Figure 5-103.

**21.** Install the check valves to the valve assembly in the rod port block. Torque to 45-50 ft.lbs. (61-68 Nm).

**22.** Install the counterbalance valves to the valve assembly in the rod port block. Torque to 30-35 ft.lbs. (41-48 Nm).

**23.** Install the relief valve to the valve assembly in the rod port block. Torque to 30-35 ft.lbs. (41-48 Nm).

## Tower Boom Telescope Cylinder

### DISASSEMBLY

**NOTICE**

**DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.**

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

**⚠ WARNING**

**DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE**

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable..
3. Remove the counterbalance valves, check valves, shuttle valve, fitting, orifice and plugs from the valve assembly.
4. Remove the capscrews securing the valve assembly to the rod, then remove the valve assembly.
5. Place the cylinder barrel into a suitable holding fixture.

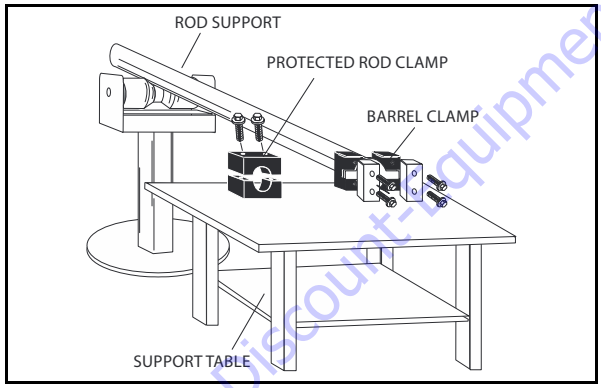



**Figure 5-113. Cylinder Barrel Support**

6. Loosen and remove the plug from cylinder barrel end.
7. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer capscrews, and remove capscrews, washers, and mounting plate from cylinder barrel, as applicable.

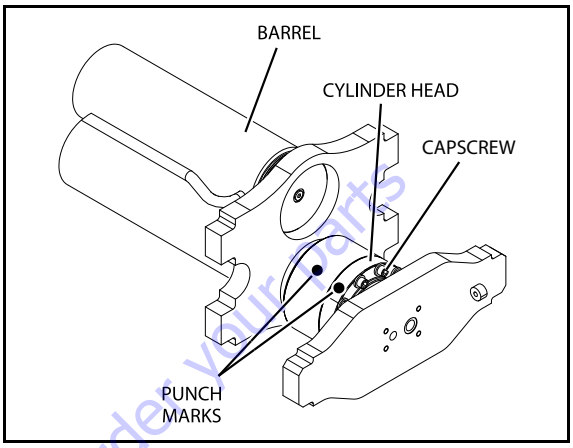



**Figure 5-114. Capscrew Removal**

8. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

**NOTICE**

**EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.**

9. With the barrel clamped securely, apply pressure to the rod pulling device and carefully remove the complete rod 1 assembly from the cylinder barrel.

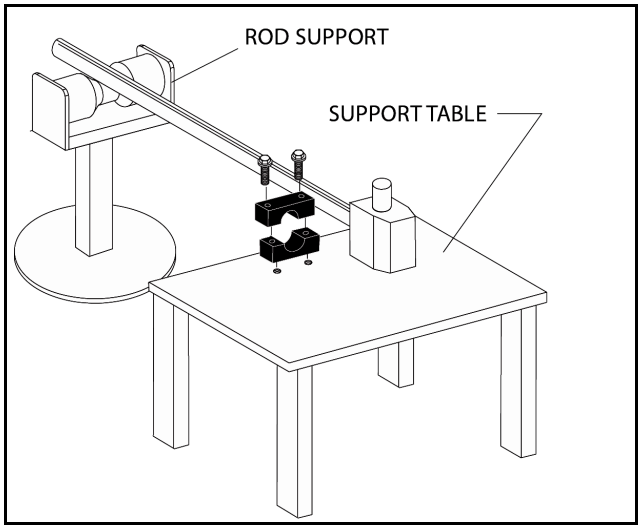
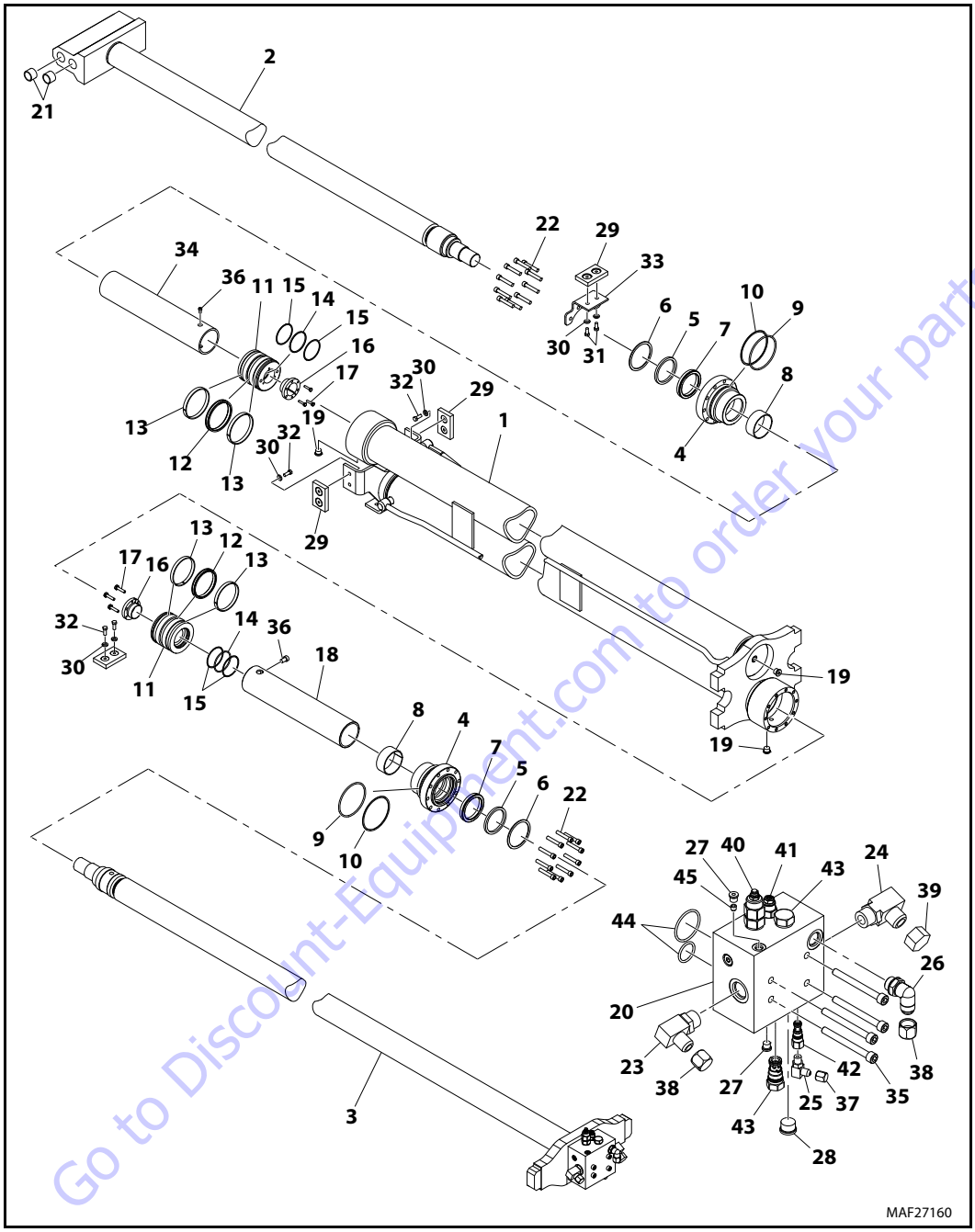


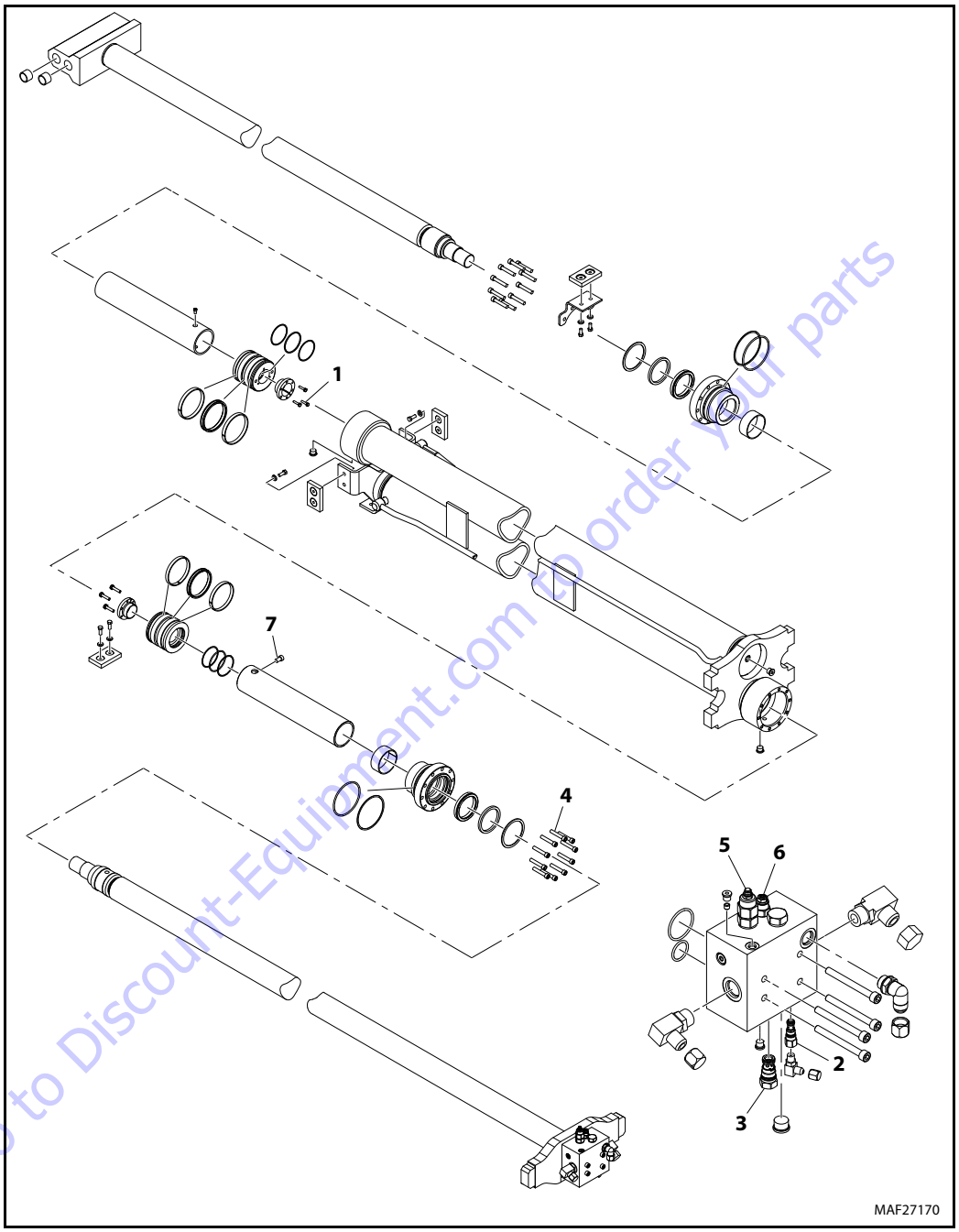

**Figure 5-115. Cylinder Rod Support**






1. Barrel
2. Rod
3. Rod
4. Head
5. Wiper Seal
6. Retaining Ring
7. Rod Seal
8. Wear Ring
9. O-Ring
10. Backup Ring
11. Piston
12. Seal
13. Wear Ring
14. O-Ring
15. Backup Ring
16. Tapered Bushing
17. Capscrew
18. Spacer
19. Plug
20. Valve Assembly
21. Bushing
22. Bolt
23. Connector
24. Connector
25. Connector
26. Connector
27. Plug
28. Plug
29. Wear Pad
30. Washer
31. Bolt
32. Bolt
33. Mounting Plate
34. Spacer
35. Bolt
36. Bolt
37. Dust Cap
38. Dust Cap
39. Dust Cap
40. Counterbalance Valve
41. Counterbalance Valve
42. Shuttle Valve
43. Check Valve
44. O-Ring
45. Orifice

**Figure 5-116. Tower Boom Telescope Cylinder**






1. Torque to 10 ft.lbs. (13 Nm)
2. Torque to 20-25 ft.lbs. (27-34 Nm)
3. Torque to 45-50 ft.lbs. (61-68 Nm)
4. Torque to 55 ft. lbs. (75 Nm)
5. Torque to 45-50 ft. lbs. (61-68 Nm)
6. Torque to 30-35 ft. lbs. (41-48 Nm)
7. Torque to 24 ft. lbs. (33 Nm)

**Figure 5-117. Tower Boom Telescope Cylinder Torque Values**

10. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
11. Remove capscrews from drilled holes
12. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen from the piston.
13. Remove the tapered bushing from the piston.

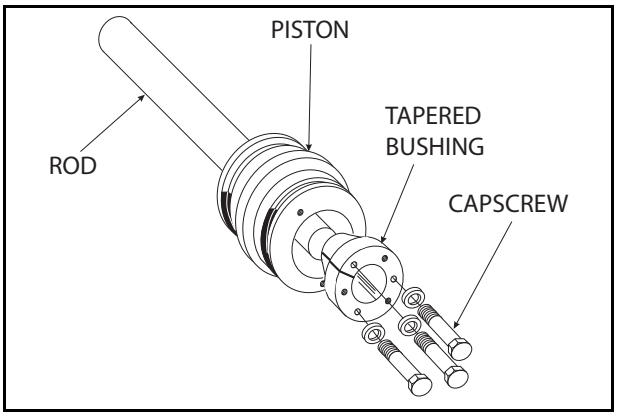



**Figure 5-118. Tapered Bushing Removal**

14. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
15. Remove and discard the piston seal, o-rings, backup rings and wear rings.
16. Loosen and remove the capscrew from spacer. Remove the spacer from the cylinder rod.
17. Remove the rod from the holding fixture. Remove capscrews, washer and wear pad.Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, retaining ring and wiper seals.
18. Repeat the steps 1 through 15 for the removal of rod 2 from the cylinder barrel.
19. Remove the piston spacer from the rod. Discard the o-rings.
20. Remove the rod from the holding fixture, Remove capscrews, washers, mounting plate, wear pad. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, retaining ring and wiper seals.

## CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. Inspect spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
12. If applicable, inspect port block fittings and holding valve. Replace as necessary.
13. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
14. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

### ASSEMBLY

***NOTE:*** *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

***NOTE:*** *Apply a light film of hydraulic oil to all components prior to assembly.*

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

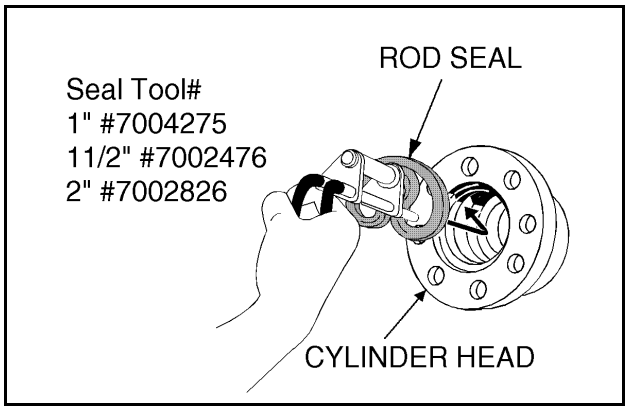



**Figure 5-119. Rod Seal Installation**

**NOTICE**

**WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.**

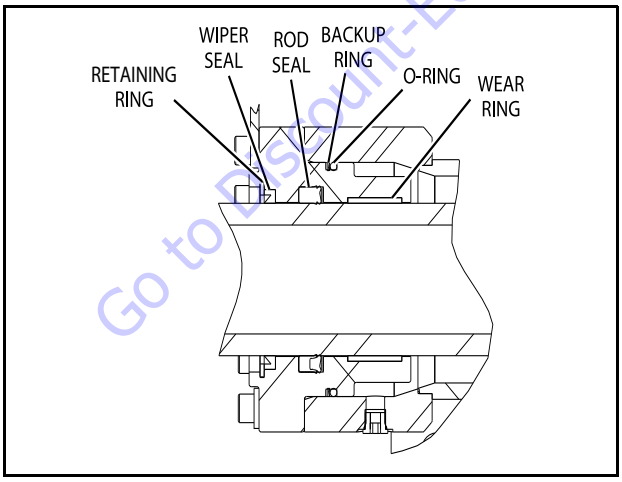



**Figure 5-120. Cylinder Head Seal Installation**

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring and retainer ring into the applicable cylinder head gland groove.

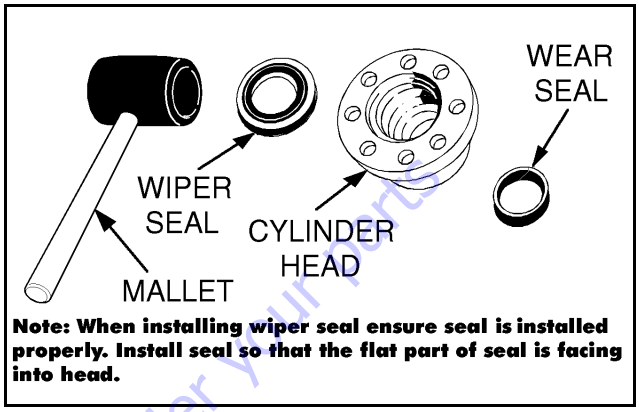



**Figure 5-121. Wiper Seal Installation**

3. Place a new o-ring and backup ring in the applicable outside diameter groove of the cylinder head.

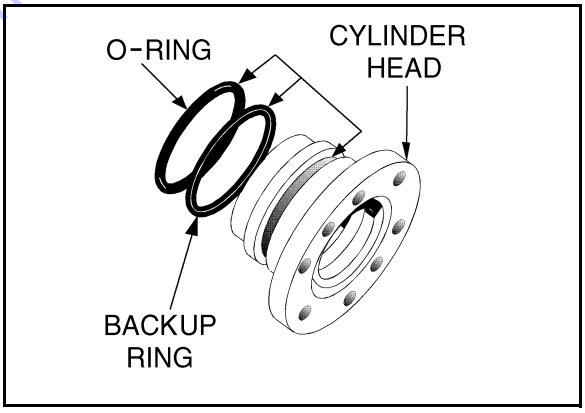



**Figure 5-122. Installation of Head Seal Kit**

4. Install the head gland on the rod 2, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.
5. Insert o-rings into spacer inner groove.
6. Carefully slide the piston spacer onto the cylinder rod, ensuring spacer o-rings are not dislodge and damaged.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
8. Place a new o-ring and backup rings in the inner piston diameter groove.
9. Carefully thread the piston on the cylinder rod and hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.
10. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

***NOTE:*** *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

11. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

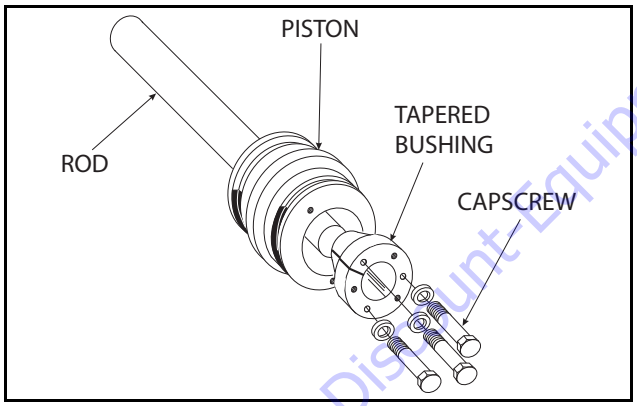



**Figure 5-123. Tapered Bushing Installation**

12. Tighten the capscrews evenly and progressively in rotation to 9 ft. lbs. (12 Nm).
13. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;
    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.
    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

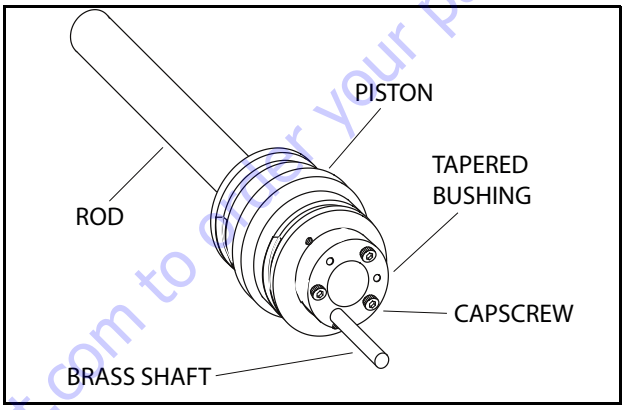



**Figure 5-124. Seating the Tapered Bearing**

14. Rotate the capscrews evenly and progressively in rotation to 9 ft. lbs. (12 Nm).

15. Remove the cylinder rod from the holding fixture.

16. Place new piston seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

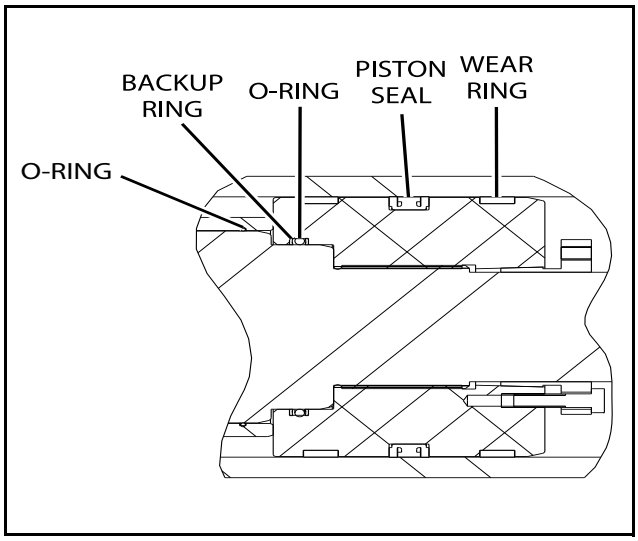



**Figure 5-125. Piston Seal Kit Installation**

17. Position the cylinder barrel in a suitable holding fixture.

**NOTICE**

**EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.**

18. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. ensuring that the piston loading wear ring and piston seals are not damaged or dislodged.

19. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

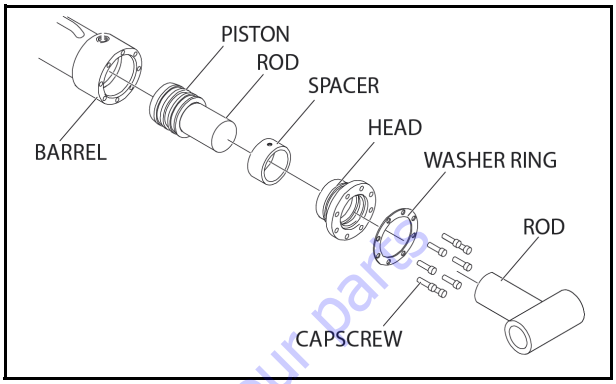



**Figure 5-126. Rod Assembly Installation**

20. Install the mounting plate onto the cylinder head.

21. Apply Medium Strength Threadlocking Compound to the socket head bolts and secure the cylinder head gland using the washer and bolts. Torque bolts to 55 ft.lbs. (74.5 Nm).

22. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.

23. Insert and tighten the plug to cylinder barrel end. Torque to 34-38.5 ft. lbs. (46-52 Nm).

24. Repeat steps 1 through 5 for the assembly of rod 1 to the barrel.

25. Carefully slide the spacer onto the rod and secure with the capscrew. Torque to capscrew to 19 ft. lbs. (25 Nm).

26. Repeat steps 7 through 23 for the assembly of rod 1 to the barrel.

27. Install the valve assembly. Torque capscrews to 48 ft. lbs. (65 Nm).

28. Install the counterbalance valves, check valves, shuttle valve, fitting, orifice and plugs to the valve assembly. Torque to as shown in Figure 5-116., Tower Boom Telescope Cylinder.

## 5.4 PRESSURE SETTING PROCEDURE

Cold temperatures have a significant impact on pressure readings. JLG Industries Inc. recommends operating the machine until the hydraulic system has warmed to normal operating temperatures prior to checking pressures. JLG Industries Inc. also recommends the use of a calibrated gauge. Pressure readings are acceptable if they are within ± 5% of specified pressures.

To ensure all pressures are set correctly, the following procedures must be followed in order.

1. Set up of the function pump.
2. Adjustments made at the main valve bank.
3. Adjustments made at the main boom valve.
4. Adjustments made at the frame valve bank.
5. Adjustments made at the platform valve bank.
6. Adjustments made in the Traction Circuit.

### Set up of the Function Pump

#### PRESSURE COMPENSATOR (PC) SETTING

1. Install a high pressure gauge 5000 psi (345 bar) at the MP port of the main valve block.
2. Remove the Tower TELE IN coil.
3. Using the Analyzer, go to service mode --> set pressures --> passcode: 32376, select Tower telescope in.
4. Activate tower tele-in (tower down switch position). The gauge should read 4000 psi (276 bar). To make an adjustment to this pressure, go back to the engine compartment to the function pump which is the rear pump. The high pressure relief adjustment is the adjustment closest to the pump case.
5. Loosen the locking set screw at the side of the adjustment. Adjust the PC to obtain 4000 psi (276 bar), clockwise increases pressure.
6. After adjusting the pressure, tighten the locking set screw, and reconnect the Tele-in coil.

#### STAND BY PRESSURE OR LOAD (LS) SENSE PRESSURE

1. Install a low pressure gauge at port "MP" of the main valve block. The gauge must be capable of reading 500 psi (34.5 bar).
2. Start the engine, the gauge should read 500psi (34.5 bar).
3. To make an adjustment to this pressure, go to the engine compartment, locate the function pump. The stand by adjustment is the adjustment outside adjustment. Using the same procedure as in the (PC) setting above adjust (LS) to 500psi (34.5 bar). Shut down the engine and restart to confirm setting.

### Adjustments made at the Main valve bank

#### REDUCED PRESSURE SECTION

1. Install pressure gauge (5000 psi) at port MP5. Using the analyzer, go to service mode --> hyd warm up --> passcode: 12671. An alternative method is to unplug the temperature switch on tank manifold with the engine less than normal operating temperature. Adjust the relief valve located at 2 o'clock behind port P5, to obtain a gauge reading of 3600 psi (248 bar) and lock. Exit hydraulic warm up mode.
2. Install pressure gauge (5000 psi) at port MPT1.
3. Using the Analyzer, go to service mode --> set pressures --> passcode: 32376, select Tower telescope in.
4. Activate tower tele-in.
5. The gauge should read 3200 psi (221 bar). Adjust the pressure reducing value, located at 3 o'clock behind port P5, until gauge reads 3200 psi (221 bar) and lock.

#### TOWER LIFT UP

1. Install a high pressure gauge at the M5 port of the main valve block.
2. Plug and cap the hose on port 5.
3. Using the Analyzer, go to service mode --> passcode: 32376, select Tower lift up.
4. Activate lift up.
5. The gauge should read 3700 psi. (255bar). the adjustment cartridge is located to the right of port M5. Turn clockwise to increase pressure, counter clockwise to decrease.

#### TOWER LIFT DOWN

**NOTICE**

**WHEN SETTING PRESSURE, IF ANY FUNCTION MOVEMENT IS OBSERVED, STOP PRESSURE SETTING PROCESS.**

1. Install a high pressure gauge at the M4 port of the main valve block.
2. Using the Analyzer, go to service mode --> set pressures --> passcode: 32376, select Tower lift down.
3. Activate lift down. The gauge should read 1800 psi (124bar). The adjustment cartridge is located to the left of the MS2. Turn clockwise to increase, counterclockwise to decrease.

### SWING

1. Install a high pressure gauge at port MS2.
2. Install the turntable lock pin.
3. Activate swing RIGHT, the gauge should read 2000 psi (138 bar).
4. The adjustment cartridge is located to the bottom rear cartridge. Turn counterclockwise to increase, clockwise to decrease.
5. Install gauge at MS3.
6. Activate swing LEFT, the gauge should read 2000 psi. (138bar), the adjustment is located to the bottom front cartridge, Turn counterclockwise to increase pressure, clockwise to decrease pressure.

### TOWER TELESCOPE OUT

1. Install a high pressure gauge at the M8 port of the main valve bank.
2. Plug the telescope out hose either at the valve bank (port #8) or at the inlet of the telescope cylinder (V1).
3. Using the Analyzer, go to service mode --> set pressures --> passcode: 32376, select Tower telescope out.
4. Activate telescope out. The gauge should read 2850 psi. (196bar), the adjustment cartridge is to the right of M8 gauge port. Turn clockwise to increase, counterclockwise to decrease.

### TOWER TELESCOPE IN

**NOTICE**

**WHEN SETTING PRESSURE, IF ANY FUNCTION MOVEMENT IS OBSERVED, STOP PRESSURE SETTING PROCESS.**

1. Install a high pressure gauge at the M7 port of the main valve block.
2. Using the Analyzer, go to service mode --> set pressures --> passcode: 32376, select Tower telescope in.
3. Activate telescope in. The gauge should read 2500 psi (172 bar). The adjustment cartridge is to the left of the rear cartridge behind MS2. Turn clockwise to increase, counterclockwise to decrease.

## Pressure on Main boom valve

### MAIN TELE OUT

1. Install 1 high pressure gauge at port M2.
2. Disconnect main tele out hose cap port & plug hose at port 2 on valve bank or ext & tele cylinder.
3. Activate tele out & adjust gauge should read 2500 psi (172 Bar). Adjustment is above port M2, clockwise increases pressure and counterclockwise decreases pressure.

### MAIN TELE IN

1. Install 1 high pressure gauge at M1.
2. Disconnect main tele in hose plug hose & cap port 1 on valve or at cylinder port ext.
3. Activate main tele in and adjust gauge should read 3000 psi (138 bar). Adjustment is located on the end of the valve opposite platform, clockwise increases pressure, counterclockwise reduces pressure.

### MAIN LIFT UP

1. Install high pressure gauge at port M5.
2. Disconnect hose from port 5 cap adaptor & plug hose.
3. Using the Analyzer, go to service mode --> passcode: 20290, select Main lift up.
4. Activate main lift up, gauge should read 3700 psi (255 bar). Adjustment is located at 7 o'clock to port 4, clockwise increases pressure, counterclockwise decreases pressure.

### MAIN LIFT DOWN

**NOTICE**

**WHEN SETTING PRESSURE, IF ANY FUNCTION MOVEMENT IS OBSERVED, STOP PRESSURE SETTING PROCESS.**

1. Install high pressure gauge at port M4.
2. Lift main boom up approximately 5° above the rest.
3. Using the Analyzer, go to service mode --> set pressures --> passcode: 32376, select Main lift down.
4. Activate main lift down.
5. Gauge should Read 1500 psi (103 bar). Adjustment is located at 2 o'clock to port 6, clockwise increases pressure, counterclockwise decreases pressure.

## Adjustments made at the Frame valve bank

### AXLE EXTEND AND RETRACT, FRONT AND REAR

1. To extend the axles drive the machine back and forth until extended. A machine that cannot be driven must be jacked up.
2. On both the front and rear frame valve banks install a high pressure gauge on ports "MA1" for extend and "MA2" for retract.
3. The gauge should read 2500 psi, for both directions. Turn clockwise to increase, counterclockwise to decrease.

### STEERING, FRONT AND REAR

***NOTE:*** *Use steer sensor calibration to steer each wheel individually.*

4. The axles must be extended to set the steer pressures.
5. Install a high pressure gauge at MS2 and MS4 gauge ports for steer right (extend), adjust to 2000 psi (138 bar), and MS1 and MS3 for steer left (retract).
6. Adjust to 2600 psi (179 bar), on both the front and rear valves.
7. Each relief valve is located next to its own gauge port. Turn clockwise to increase, counterclockwise to decrease.

## Adjustments made at the Platform valve bank

### PLATFORM LEVEL UP

1. Install a high pressure gauge at gauge port ML1.
2. Activate level up to the end of Stroke, you should read 3000 psi (207bar).
3. All the relief valves are located on the same Face. The level up relief valve is near the top towards the centerline of valve. Turn clockwise to increase, counterclockwise to decrease.

### PLATFORM LEVEL DOWN

1. Install a high pressure gauge at gauge port ML2.
2. Activate level down to the end of stroke, you should read 3000 psi (207bar).
3. The level down relief valve is near the top towards the outside of this valve. Turn clockwise to increase, counterclockwise to decrease.

### JIB LIFT UP

1. Install high pressure gauge at port MJ1.
2. Fully extend jib lift cylinder or cap port J1.
3. Set pressure to 2800 psi. (193bar). Clockwise increases and counterclockwise decreases setting. Adjustment is on the boom side of MJB. Adjustment is towards the bottom of the valve towards the centerline of the valve.

#### JIB LIFT DOWN

1. Install high pressure gauge at port MJ2.
2. Fully retract jib lift cylinder or cap port J1.
3. Set pressure to 1500 psi. (103bar). Clockwise increases and Counterclockwise decreases setting. Adjustment is on the boom side of MJA. Adjustment is towards the bottom of the valve towards the outside of the valve.

### Adjustments made in Traction circuit

#### CHARGE PRESSURE RELIEF

1. Install gauge 1000psi (69bar) at port M3 on traction pump.
2. With the drive hubs disconnected, start the engine.
3. Adjust the charge relief valve to obtain reading of 400psi (28bar). The charge relief is located on the turntable side of the pump above M3. Clockwise increases pressure, Counterclockwise decreases pressure

#### LOOP FLUSHING RELIEF

1. Install pressure gauge at port MP on traction valve.
2. With hubs still disconnected, activate Drive.
3. Adjust loop flushing valve to obtain gauge reading of 350psi (24bar). Clockwise increases pressure, counterclockwise decreases.

## 5.5 HYDRAULIC SYSTEM WARM UP

For optimal life and performance of the hydraulic system in extremely cold temperatures, the control system monitors the hydraulic system temperature and automatically limits the function speeds of the high demand functions.

While the system is cold and in the warm up mode, the tower lift, main lift, and main telescope functions are limited to creep speeds and is indicated to the operator by flashing the creep light on the platform control panel.

Operating the machine while in the warm up mode will generate sufficient heat to bring the hydraulic temperature up to allowable temperatures and the warm up mode will be automatically turned off.

This system is activated when the hydraulic oil temperature in the return manifold is below 30°F (-1°C) and the engine coolant temperature is below 150°F (65°C). In warm up, the engine operates at mid engine speed and a valve is energized which loads the pump to build heat. This valve is active only when no function is selected. Warm up ends when the return manifold temperature reaches 50°F (10°C) or the engine coolant reaches 150°F (65° C). Functions being operated when the warm up mode turns off will remain in the creep speed until the function is re-initiated.

## 5.6 DRIVE PUMPS

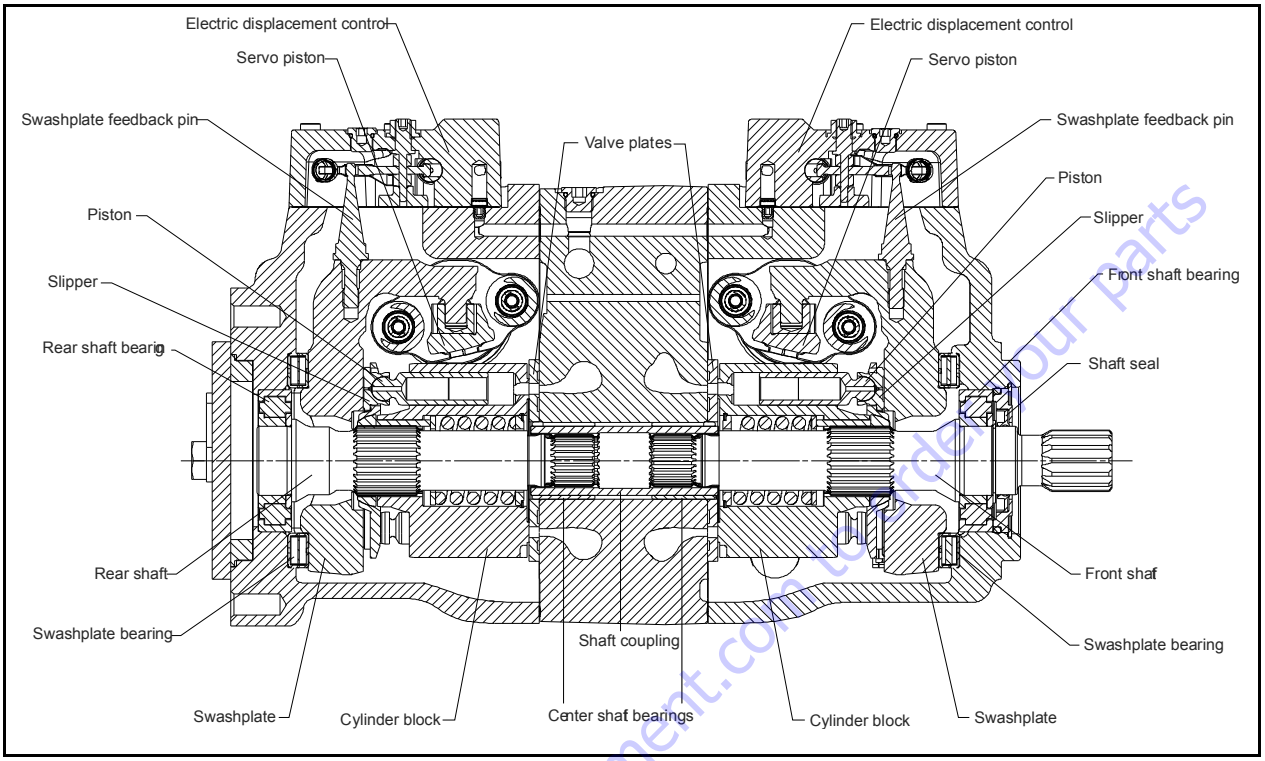



**Figure 5-127. Piston Pump Cross Sectional View**

## Port Locations and Gauge Installation

**Table 5-33. Port information**

| Port identifier | Port size | Wrench size | Reading | Gauge size, bar [psi] |
|---|---|---|---|---|
| L1, L2, L3 | 1 1/16-12 UNF 2B | 9/16 internal hex | Case drain | 10 bar [100 psi] |
| MA, MB, MC, MD | 9/16-18 UNF | 1/4 internal hex | System pressure | 600 bar [10,000 psi] |
| M3 | 9/16-18 UNF 2B | 1/4 internal hex | Charge pressure | 50 bar [1000 psi] |
| M4, M5 | 7/16-20 UNF 2B | 3/16 internal hex | Servo pressure | 50 bar [1000 psi] |
| X7 | 9/16-18 UNF 2B | 1/4 internal hex | Brake pressure | 50 bar [1000 psi] |

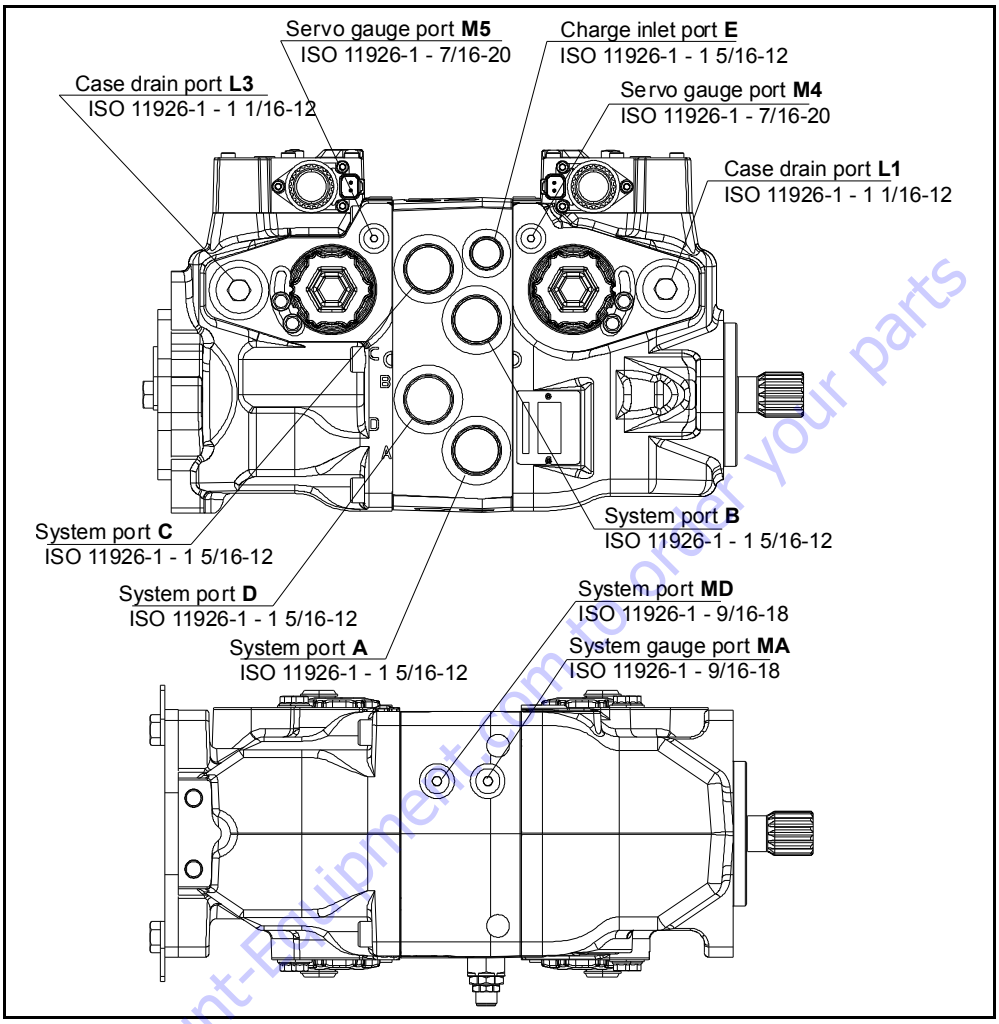



**Figure 5-128. Port locations - Sheet 1 of 2**

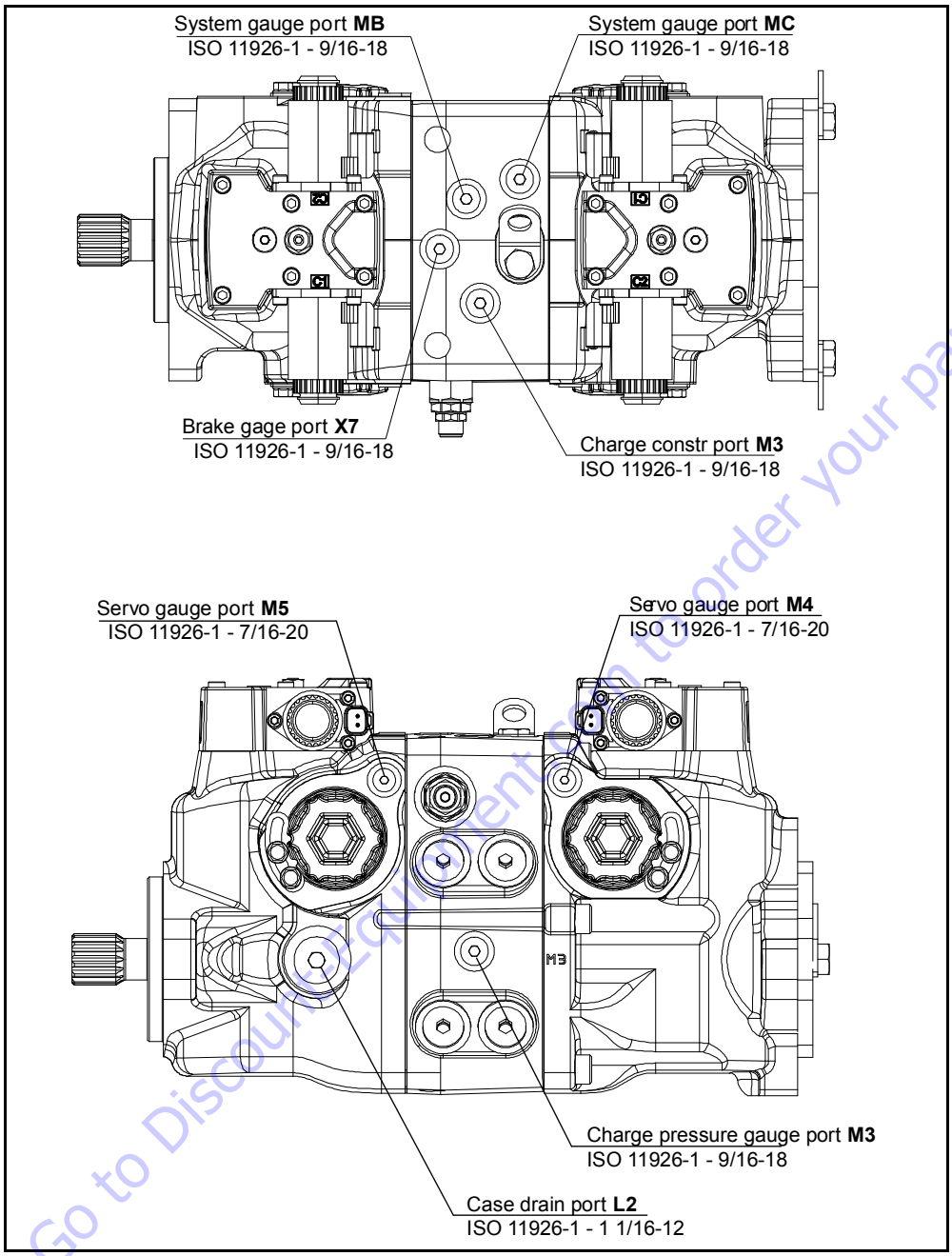





**Figure 5-129. Port locations - Sheet 2 of 2**

## Initial Startup Procedures

Follow this procedure when starting-up a new pump or when restarting a pump that has been removed. Ensure the pump is thoroughly tested on a test stand before installing.

Prior to installing the pump, inspect for damage that may have occurred during shipping.

1. Ensure that the machine hydraulic oil and system components (reservoir, hoses, valves, fittings, and heat exchanger) are clean and free of any foreign material.
2. Install new system filter element(s) if necessary. Check that inlet line fittings are properly tightened and free of air leaks.
3. Install the pump. Install a 50 bar [1000 psi] gauge in the charge pressure gauge port M3.
4. Fill the housing by adding filtered hydraulic fluid to the upper case drain port. If the controls are installed on top, open the construction plugs in the top of the controls to assist in air bleed.
5. Fill the reservoir with hydraulic fluid of the recommended type and viscosity. Use a 10-micron filler filter. Ensure construction plug is closed after filling is complete.
6. Disconnect the pump from all control input signals.

**⚠ CAUTION**

**AFTER START-UP THE FLUID LEVEL IN THE RESERVOIR MAY DROP DUE TO SYSTEM COMPONENTS FILLING DAMAGE TO HYDRAULIC COMPONENTS MAY OCCUR IF THE FLUID SUPPLY RUNS OUT. ENSURE RESERVOIR REMAINS FULL OF FLUID DURING START-UP.**

**⚠ CAUTION**

**AIR ENTRAPMENT IN OIL UNDER HIGH PRESSURE MAY DAMAGE HYDRAULIC COMPONENTS. CHECK CAREFULLY FOR INLET LINE LEAKS.**

**⚠ CAUTION**

**DO NOT RUN AT MAXIMUM PRESSURE UNTIL SYSTEM IS FREE OF AIR AND FLUID HAS BEEN THOROUGHLY FILTERED.**

7. Use a common method to disable the engine to prevent it from starting. Crank the starter for several seconds. Do not to exceed the engine manufacturer's recommendation. Wait 30 seconds and then crank the engine a second time as stated above. This operation helps remove air from the system lines. Refill the reservoir to recommended full oil level.
8. When the gauge begins to register charge pressure, enable and start engine. Let the engine run for a minimum of 30 seconds at low idle to allow the air to work itself out of the system. Check for leaks at all line connections and listen for cavitation. Check for proper fluid level in reservoir.
9. When adequate charge pressure is established (as shown in model code), increase engine speed to normal operating rpm to further purge residual air from the system.
10. Shut the off engine. Connect the pump control signal. Start the engine, checking to be certain the pump remains in neutral. Run the engine at normal operating speed and carefully check for forward and reverse control operation.
11. Continue to cycle between forward and reverse for at least five minutes to bleed all air and flush system contaminants out of the system loop.

***NOTE:*** *Normal charge pressure fluctuation may occur during forward and reverse operation.*

12. Check that the reservoir is full. Remove charge pressure gauge and cap port. The pump is now ready for operation.

## Troubleshooting

**⚠ CAUTION**

**HIGH INLET VACUUM CAUSES CAVITATION WHICH CAN DAMAGE INTERNAL PUMP COMPONENTS.**

**⚠ WARNING**

**ESCAPING HYDRAULIC FLUID UNDER PRESSURE CAN HAVE SUFFICIENT FORCE TO PENETRATE YOUR SKIN CAUSING SERIOUS INJURY AND/OR INFECTION AND MAY BE HOT ENOUGH TO CAUSE BURNS. RELIEVE PRESSURE IN THE SYSTEM BEFORE REMOVING HOSES, FITTINGS, GAUGES, OR COMPONENTS. SEEK IMMEDIATE MEDICAL ATTENTION IF YOU ARE CUT OR BURNED BY HYDRAULIC FLUID.**

**⚠ CAUTION**

**CONTAMINATION CAN DAMAGE INTERNAL COMPONENTS. TAKE PRECAUTIONS TO ENSURE SYSTEM CLEANLINESS WHEN REMOVING AND REINSTALLING SYSTEM COMPONENTS AND LINES**

**Table 5-34. Electrical troubleshooting**

| Item | Description | Action |
|---|---|---|
| Control operates pump in one direction only | Control coil failure. | Measure resistance at coil pins. Resistance should be 14.2W (24V) or 3.66W (12V) at 20°C [70°F]. Replace coil. |
| No pump function | No power to controller. | Restore power to controller. |
| Erratic pump function | Electrical connection to pump is bad. | Disconnect connection, check wires, reconnect wires. |
| Erratic or no machine function | External controller malfunction or hydraulic system problem. | Verify external controller problem using spare controller. Replace controller. Check hydraulic system fluid level/pressures/filters/etc. Fix hydraulic system problems. |

**Table 5-35. Neutral difficult or impossible to find**

| Item | Description | Action |
|---|---|---|
| Input to pump control | Input to control module is operating improperly. | Disconnect input and check to see if pump comes back to neutral. If Yes, input fault, replace/repair external controller. If No, go to next step. |
| Pump control neutral | Neutral set improperly. | Shunt servo gauge ports M4 and M5 together with external hose and see if pump comes back to neutral. If Yes: control neutral improperly set. If no: balance swashplate (see Mechanical neutral adjustment). If you still cannot set neutral, replace control. |

**Table 5-36. System operating hot**

| Item | Description | Action |
|---|---|---|
| Oil level in reservoir | Insufficient hydraulic fluid will not meet cooling demands of system. | Fill reservoir to proper level. |
| Heat exchanger | Heat exchanger not sufficiently cooling the system. | Check air flow and input air temperature for heat exchanger. Clean, repair or replace heat exchanger. |
| Charge pressure | Low charge pressure will overwork system. | Measure charge pressure. Inspect and adjust or replace charge relief valve. Inspect charge pump. Repair or replace charge pump. |
| Charge pump inlet vacuum | High inlet vacuum will overwork system. A dirty filter will increase the inlet vacuum. Inadequate line size will restrict flow. | Check charge inlet vacuum. If high, inspect inlet filter and replace as necessary. Check for adequate line size, length or other restrictions. |
| System relief pressure settings | If the system relief valves are worn, contaminated, or valve settings are too low, the relief valves will be overworked. | Verify settings of high pressure relief valves and replace valves as necessary. |
| System pressure | Frequent or long term operation over system relief setting will create heat in system. | Measure system pressure. If pressure is too high, reduce loads. |

**Table 5-37. System will not operate**

| Item | Description | Action |
|---|---|---|
| Oil level in reservoir | Insufficient hydraulic fluid to supply system loop. | Fill reservoir to proper level. |
| Control orifices | Control orifices are blocked. | Clean control orifices. |
| Control screens | Control screens are blocked. | Clean or replace control screens. |
| Charge pressure with pump in neutral | Low charge pressure insufficient to recharge system loop. | Measure charge pressure with the pump in neutral. If pressure is low, go to next step. |
| Pump charge relief valve | A pump charge relief valve that is leaky, contaminated, or set too low will depressurize the system. | Adjust or replace pump charge relief valve as necessary. |
| Charge pump inlet filter | A clogged filter will under supply system loop. | Inspect filter and replace if necessary. |
| Charge pump | A malfunctioning charge pump will provide insufficient charge flow. | Repair or replace the charge pump. |
| System pressure | Low system pressure does not provide enough power to move load. | Measure system pressure. Continue to next step. |
| Charge check / HPRVs | Defective charge check / HPRVs cause system pressure to be low. | Repair or replace charge check / HPRVs. |
| Input to control | Input to control module is operating improperly. | Repair or replace control. |
| Optional control cutoff valve | Control cutoff valve coil not energized. | Ensure charge pressure to control via port X7. If none, confirm control cutoff valve coil is energized. If still no pressure, repair or replace control cutoff valve. |

**Table 5-38. System noise or vibration**

| Item | Description | Action |
|---|---|---|
| Reservoir oil level | Low oil level leads to cavitation. | Fill reservoir. |
| Aeration of the oil/pump inlet vacuum | Air in system decreases efficiency of units and controls. Air in system is indicated by excessive noise in pump, foaming in oil, and hot oil. | Find location where air is entering into the system and repair. Check that inlet line is not restricted and is proper size. |
| Cold oil | If oil is cold, it may be too viscous for proper function and pump cavitates. | Allow the oil to warm up to its normal operating temperature with engine at idle speed. |
| Pump inlet vacuum | High inlet vacuum causes noise/cavitation. | Check that inlet line is not restricted and is proper size. Check filter and bypass switch. |
| Shaft couplings | A loose input shaft to prime mover coupling will cause excessive noise. | Replace loose shaft coupling. |
| Shaft alignment | Misaligned input and prime mover shafts create noise. | Correct misalignment. |
| Charge/system relief valves | Unusual noise may indicate sticking valves. Possible contamination. | Clean/replace valves and test pump. May be a normal condition. |

**Table 5-39. Sluggish system response**

| Item | Description | Action |
|---|---|---|
| Oil level in reservoir | Low oil level will cause sluggish response. | Fill reservoir. |
| Charge check / HPRVs | Incorrect pressure settings will affect system reaction time. | Replace charge check / HPRVs. |
| Low prime mover speed | Low engine speed will reduce system performance. | Adjust engine speed. |
| Charge and control pressures | Incorrect pressures will affect system performance. | Measure and adjust charge and control pressures. |
| Air in system | Air in system will produce sluggish system response. | Fill tank to proper level. Cycle system slowly for several minutes to remove air from system. |
| Contaminated control orifices | Control orifices are plugged. | Clean control orifices. |
| Contaminated control screens | Control screens are plugged. | Clean or replace control screens. |
| Pump inlet vacuum | Inlet vacuum is too high resulting in reduced system pressure. | Measure charge inlet vacuum. Inspect line for proper sizing. Replace filter. Confirm proper bypass operation. |

## Adjustments

**⚠ CAUTION**

**CONTAMINATION CAN DAMAGE INTERNAL COMPONENTS AND VOID YOUR WARRANTY. TAKE PRECAUTIONS TO ENSURE SYSTEM CLEANLINESS WHEN REMOVING AND REINSTALLING SYSTEM LINES**

1. Thoroughly clean the outside of the pump.
2. If removing the pump, tag each hydraulic line. When you disconnect hydraulic lines, cap them and plug each open port to prevent contamination.
3. Ensure the surrounding area is clean and free of contaminants like dirt and grime.
4. Inspect the system for contamination.
5. Check the hydraulic fluid for signs of contamination: oil discoloration, foam in the oil, sludge, or metal particles.
6. If there are signs of contamination in the hydraulic fluid, replace all filters and drain the hydraulic system. Flush the lines and refill the reservoir with the correct filtered hydraulic fluid.
7. Before reinstalling the pump, test for leaks.

### CHARGE PRESSURE RELIEF VALVE.

1. Install a 50 bar [1000 psi] pressure gauge in charge pressure gauge port M3. Install a 10 bar [100 psi] gauge at case pressure port L1, L2, or L3. Operate the system with the pump in neutral (zero displacement) when measuring charge pressure.
2. The table below shows the acceptable pump charge pressure range for some nominal charge relief valve settings (refer to model code located on serial number plate). These pressures assume 1800 min-1 (rpm) pump speed and a reservoir temperature of 50°C [120°F], and are referenced to case pressure.

***NOTE:*** *Listed pressures assume a pump speed of 1800 min-1 (rpm) and charge flow of 26.5 l/min [7 US gal/min]. At higher pump speeds or higher charge flows the charge pressure will rise over the rated setting.*

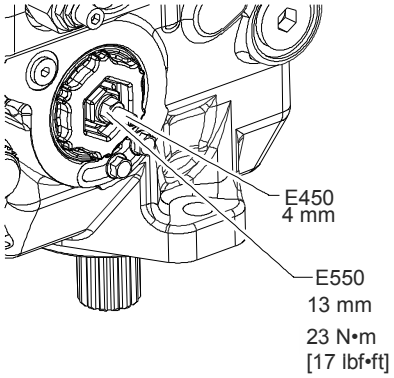
3. Loosen the locknut and rotate the adjusting screw clockwise to increase the setting; counterclockwise to decrease it. Subtract the case pressure reading to compute the actual charge pressure.

***NOTE:*** *Pressure change per turn is dependent on charge flow entering pump.*

4. While holding the adjusting screw, torque locknut to 12 Nm [9 lbft].
5. When you achieve the desired charge pressure setting, remove the gauges and plug the ports.

### DISPLACEMENT LIMITER ADJUSTMENT

1. Mark servo cylinder location in case it rotates during displacement limiter adjustment.
2. Loosen the locknut (E550).




3. Rotate the adjusting screw (E450) based on the following table. Rotating the adjusting screw clockwise decreases the maximum displacement of the pump while rotating the adjusting screw counterclockwise increases the maximum displacement.

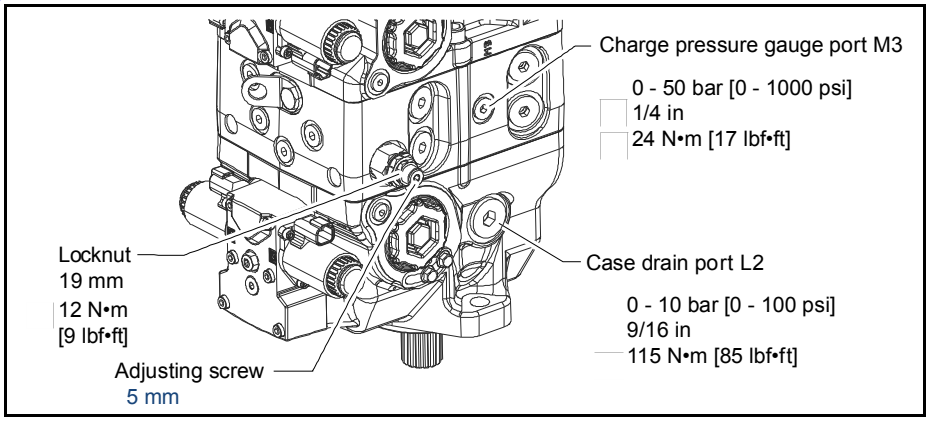



**Figure 5-130. Charge Pressure Adjustment**

4. After establishing the desired maximum displacement setting, hold adjusting screw in place and tighten the locknut. Torque to 23 Nm [17 lbft]. C

**⚠ CAUTION**

**BE SURE SERVO CYLINDER DOES NOT ROTATE WHEN DISPLACEMENT LIMITER LOCKNUT (E550) IS TORQUED.**

5. One turn of the adjusting screw will change the maximum displacement approximately as follows.

**Table 5-40. Displacement Limiter Adjustment Data**

| Displacement | Locknut wrench size and torque | Adjusting screw size | Approximate displacement change per revolution of adjusting screw |
|---|---|---|---|
| 45 | 13 mm 23 Nm [17 lbft] | 4 mm internal hex | 5.1 cc/turn |

## CONTROL NEUTRAL ADJUSTMENT

All functions of the Electric Displacement Control (EDC) are preset at the factory. Adjust the pump to neutral with the pump running on a test stand or on the vehicle/machine with the prime mover operating. If adjustment fails to give satisfactory results, you may need to replace the control or coils.

1. Install a 50 bar [1000 psi] gauge in each of the two servo gauge ports (M4 and M5). Disconnect the external control input (electrical connections) from the control. Start the prime mover and operate at normal speed.

2. Use a 4mm internal hex wrench to hold the neutral adjusting screw stationary while loosening the locknut with a 13mm wrench.

3. Observe pressure gauges. If necessary, turn adjusting screw to reduce any pressure differential.

***NOTE:*** *Adjustment of the EDC is very sensitive. Be sure to hold the hex wrench steady while loosening the locknut. Total adjustment is less than 120 degrees.*

4. Rotate the neutral adjusting screw clockwise until the pressure increases on the gauge. Note the angular position of the wrench. Then rotate the neutral adjusting screw counterclockwise until the pressure increases by an equal amount on the other gauge. Again note the angular position of the wrench.

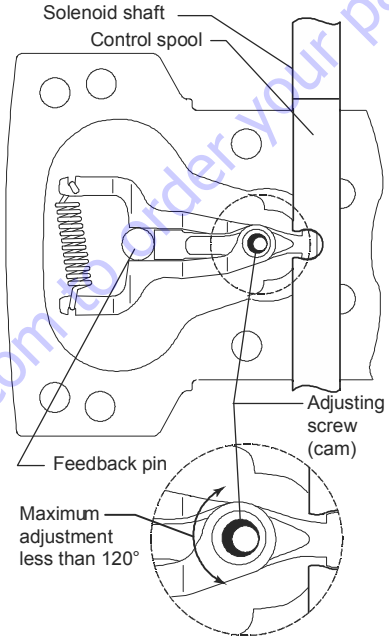



**Illustration shows how eccentric cam on adjusting screw rotates to adjust neutral.**

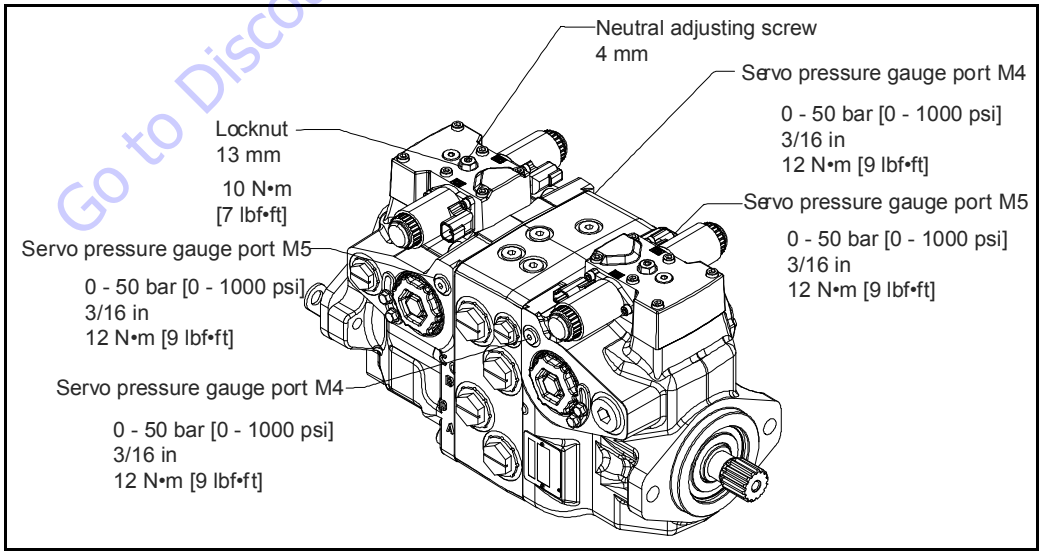



**Figure 5-131. Control Neutral Adjustment**

5. Rotate the neutral adjusting screw clockwise half the distance between the wrench positions noted above. The gauges should read the same pressure, indicating that the control is in its neutral position.

6. Hold the neutral adjusting screw stationary and tighten the lock nut. Torque to 10.Nm [7 lbft]. Do not over torque the nut.

7. When the neutral position is set, stop the prime mover, remove the gauges, and install the gauge port plugs. Reconnect the external control input.

***NOTE:*** *A small pressure differential of 1.5 bar [22 psi] or less is acceptable. Zero differential is usually not possible.*

### MECHANICAL NEUTRAL ADJUSTMENT

Mechanical neutral is set with the pump running at 1800 min (rpm). To set neutral, you must stroke the pump in each direction.

This procedure details setting neutral for the entire pump, one side at a time. The procedure is the same for each side of each pump so you will need to repeat it four times to set mechanical neutral for both the front and rear sections. Alternate M4/M5 and MA/MB to zero out forward and reverse directions of the front unit, then move the gauges to M4/M5 of the rear unit and MC/MD (system gauge ports for the rear unit). Refer to the drawing that follows to identify all ports. The front and rear sections are basically mirror images of each other. The control solenoids C1 and C2 are marked on each control.

While performing this adjustment, you monitor the following pressures.:

- Servo pressure at M4 and M5
- System pressure at MA and MB or MC and MD
- Pressure differential between M4 and M5 (optional)
- Pressure differential between A and B or C and D (optional)

### PUMP SETUP

1. Attach a 50 bar [1000 psi] gauge to each servo pressure port M4 and M5.

2. Attach a 600 bar [10 000 psi] gauge to each system pressure port (MA and MB for front pump, MC and MD for rear pump).

3. Remove servo cylinder locking screws (E350) and plates (E300) from both sides of the pump.

4. Disconnect the control solenoids from the vehicle wiring harness.

5. If using a PWM signal to set mechanical neutral, connect the control solenoids C1 and C2 to the signal source. Ensure the source supplies no current to the solenoids until required in the following procedure.

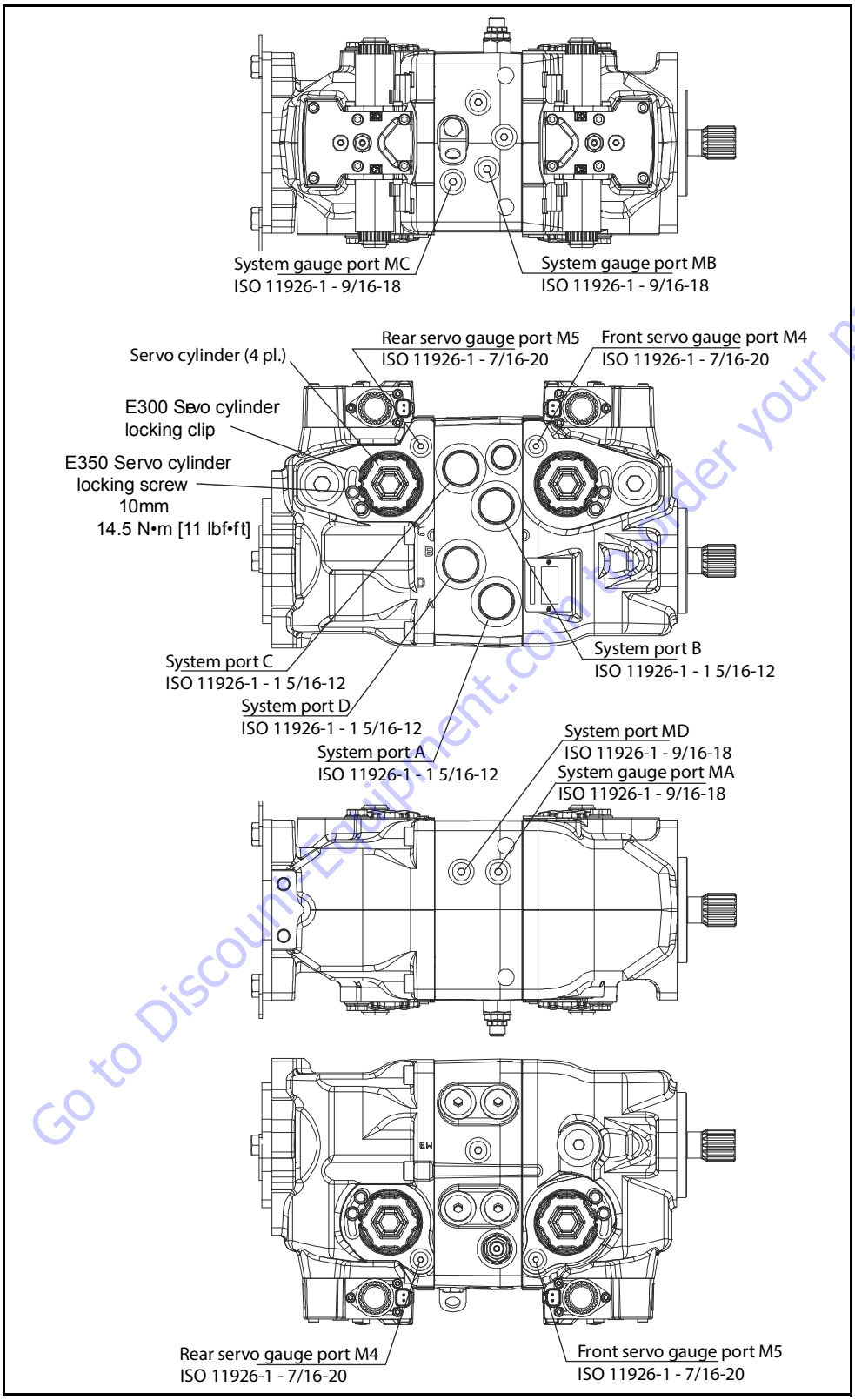



**Figure 5-132. Servo and System Pressure Gauge Port Locations**

### SERVO ADJUSTMENT

6. Run prime mover at 1800 min (rpm).

7. If using a PWM signal, ensure the signal is off. Check the servo pressure gauges. Ensure the differential between M4 and M5 is less than 1.5 bar [22 psi].

8. Using a 3/4 in deep socket, unthread both servo cylinders 2-3 turns. This step ensures the servo cylinders have no contact with the servo piston.

9. Stroke the pump by turning the control eccentric screw (or supplying current to solenoid C1) until the servo pressure at port M4 is 1 to 2 bar [14 -29 psi] greater than at port M5 and the system pressure gauges indicate displacement. Pressure should be greater at port MA for clockwise rotation, or MB for counterclockwise rotation. This also indicates the servo piston is in contact with the servo cylinder on side M5.

10. Slowly thread the servo cylinder on the M5 side in until the system pressure differential starts to decrease. Maintain servo pressure differential between 1-2 bar [14-29 psi] during this step. Continue turning the servo cylinder in until the system pressure differential (between ports MA/MB or MC/MD) is less than 1.5 bar [22 psi]. This procedure sets the servo and swashplate to mechanical neutral on the M5 side.

11. To complete setting neutral, repeat steps 1-5 but stroke the pump in the opposite direction by turning the eccentric screw in the opposite direction, or by supplying current to solenoid C2. Reverse gauge locations (M4 for M5, MB for MA etc.) from those stated above since the pump is now stroking the other direction.

12. Set neutral for the rear pump by repeating steps 1-6 on the rear pump. Remember that the rear pump is a mirror image of the front pump and therefore the locations of the servo gauge ports (M4/M5) and the control solenoids (C1/C2) are opposite.

13. Remove all gauges and replace gauge port plugs.

## Removing The Pump

Before working on the pump, thoroughly clean the outside. If the pump has an auxiliary pump attached, remove both pumps as a single unit. Tag and cap all hydraulic lines as you disconnect them, and plug all open ports to ensure that dirt and contamination do not get into the system.

**⚠ CAUTION**

**CONTAMINATION CAN DAMAGE INTERNAL COMPONENTS. TAKE PRECAUTIONS TO ENSURE SYSTEM CLEANLINESS WHEN REMOVING AND INSTALLING SYSTEM LINES.**

1. Thoroughly clean all dirt and grime from the outside of the pump.
2. Tag, disconnect, and cap each hydraulic line connected to the pump. As hydraulic lines are disconnected, plug each open port, to ensure that dirt and contamination do not get into the pump.
3. Remove the pump and its auxiliary pump (if applicable) as a single unit.

***NOTE:*** *Be careful, do not damage solenoids and electrical connections when using straps or chains to support the pump.*

## Inspection

1. Ensure the work surface and surrounding area are clean and free of contaminants such as dirt and grime.
2. Inspect the system for contamination.
3. Look at the hydraulic fluid for signs of system contamination, oil discoloration, foam in the oil, sludge, or metal particles.

## Replacement

1. Before replacing the pump, replace all filters and drain the hydraulic system. Flush the system lines and fill the reservoir with the correct, filtered hydraulic fluid.
2. Fill the pump with clean, filtered hydraulic fluid.
3. Attach the pump to the prime mover. Torque mounting screws according to the manufacturers recommendation.
4. Replace all hydraulic lines. Ensure the charge inlet line is filled with fluid.

## Electric Control Module

### REMOVAL

Refer to exploded diagram, next page.

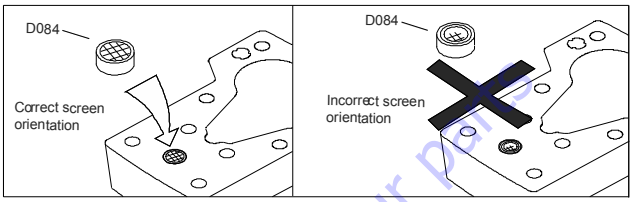
1. Using a 5 mm internal hex wrench, remove the six capscrews (D250).
2. Remove the control module and gasket (D150). Discard the gasket.
3. If necessary, remove orifices (F100) using a 3 mm internal hex wrench. Tag and number them for reinstallation.
4. Inspection
5. Inspect the machined surfaces on the control and top of the pump. If you find any nicks or scratches, replace the component.

***NOTE:*** *Remove plug on top of control to ensure the swashplate feedback pin is properly positioned in the center of the control module when installing control.*

### REASSEMBLY

***NOTE:*** *Ensure you install dowel pins (D300) in housing before installing control.*

1. Install a new gasket (D150).
2. If you removed screen (D084), install a new one. Install with the mesh facing outward.




3. If previously removed, install orifices (F100) using a 3 mm internal hex wrench. Torque to 2.5 Nm [1.8 lbft].
4. Install the control module and six capscrews (D250).
5. Using a 5 mm internal hex wrench, torque the capscrews (D250) to 13.5 Nm [10.lbft].

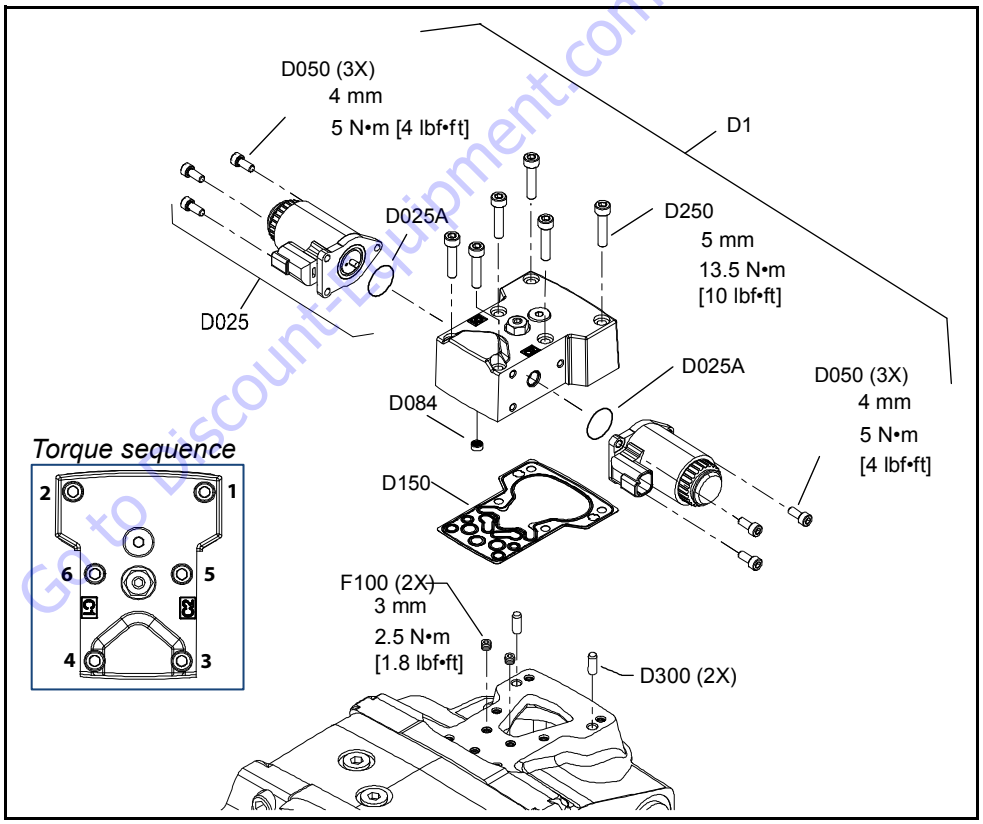



**Figure 5-133. Control Module And Solenoid Removal/installation**

### CONTROL SOLENOIDS REMOVAL

1. Disconnect electrical connection and remove the three capscrews (D050) using a 4.mm internal hex wrench.
2. Remove the solenoid (D025) and O-ring (D025A). Discard the O-ring.
3. If necessary, remove the coil using a 12 point 26 mm socket.

### CONTROL SOLENOIDS INSPECTION

1. Inspect the machined surface on the control. If you find any nicks or scratches, replace the component.

### CONTROL SOLENOIDS REASSEMBLY

1. Lubricate new O-ring (D025A) using petroleum jelly and install.
2. Install solenoid with three capscrews (D050) using a 4 mm internal hex wrench. Torque screws to 5 Nm [4 lbft].
3. Install coil using a 12 point 26 mm socket. Torque coil nut to 5 Nm [3.7 lbft].
4. Reconnect electrical connections and test the pump for proper operation.

## Shaft, Seal, and Bearing

The front pump input shaft assembly is serviceable without disassembling the pump, the rear shaft is not. Orient the pump on the work surface so the shaft is pointing to the side.

### REMOVAL

1. Unwind the spiral ring (J300) from the housing to release the shaft/seal/bearing subassembly.
2. Pry on the lip of the seal carrier (J275) to remove it from the pump. Remove the seal carrier. Remove and discard O-ring (J260). Press the seal (J250) out of the carrier and discard.
3. Pull the shaft (J100) with bearing (J150) out of the pump. If necessary, tap lightly on the shaft to dislodge it from the cylinder block. C

**⚠ CAUTION**

**DO NOT DAMAGE THE HOUSING BORE, SHAFT OR BEARING WHEN REMOVING THE SHAFT AND BEARING.**

4. Remove the retaining ring (J200) using retaining ring pliers. Press the bearing off the shaft.

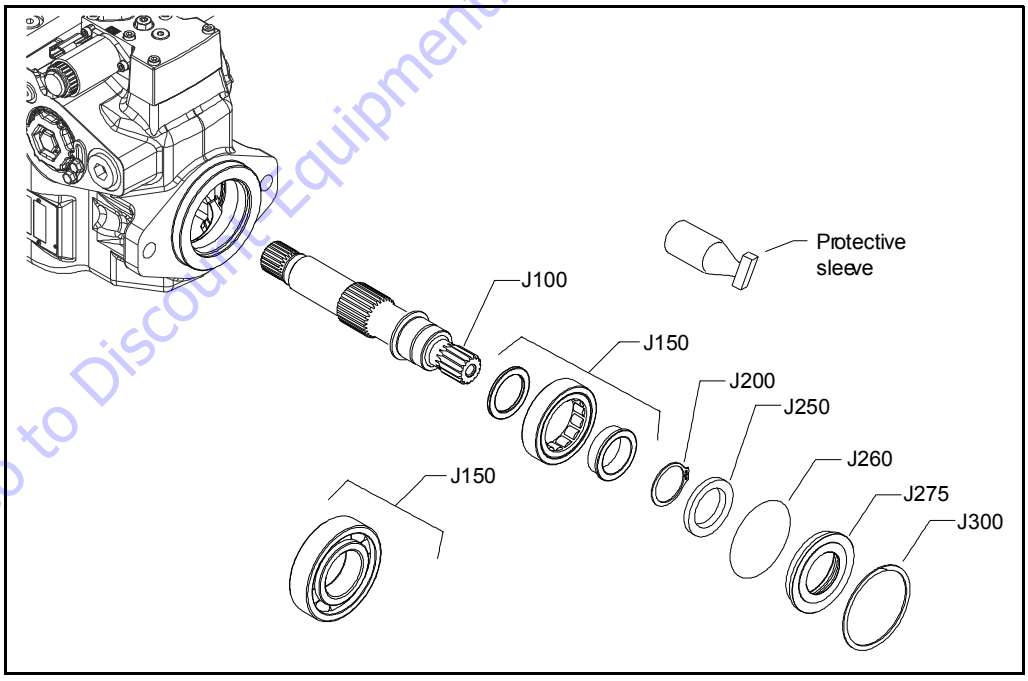


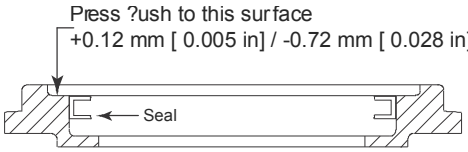

**Figure 5-134. Shaft Assembly**

### INSPECTION

1. Inspect the shaft journals for wear, scratching, and pits. Check the splines for fretting; replace if damaged. Rotate the bearing, if it does not rotate smoothly, replace it.

### REASSEMBLY

1. Press the bearing (J150) onto the shaft (J100) and replace the retaining ring (J200). Ensure the retaining ring diameter is less than 38.84 mm [1.53.in] when installed on the shaft.
2. Install the shaft/bearing assembly into the pump.
3. Lubricate and install a new O-ring (J260) onto seal carrier (J275). Press a new seal (J250) into the seal carrier. Press the seal until it is flush within +0.12mm [0.005 in] or -0.72 mm [0.0028 in] of the inside lip of the carrier: see illustration.




4. Cover the shaft with a protective sleeve while installing the seal carrier. Hand press the seal carrier into the housing. Ensure the seal carrier clears the spiral ring groove in the housing. Remove the protective sleeve.
5. Wind the spiral ring into the housing. Ensure the inside diameter of the spiral ring is greater than 68 mm [2.677 in] after installation.

## Charge Pump

Position pump with front shaft pointing downward. Attach securely to a proper work stand. If an auxiliary pump is attached, remove auxiliary pump before servicing charge pump.

### REMOVAL

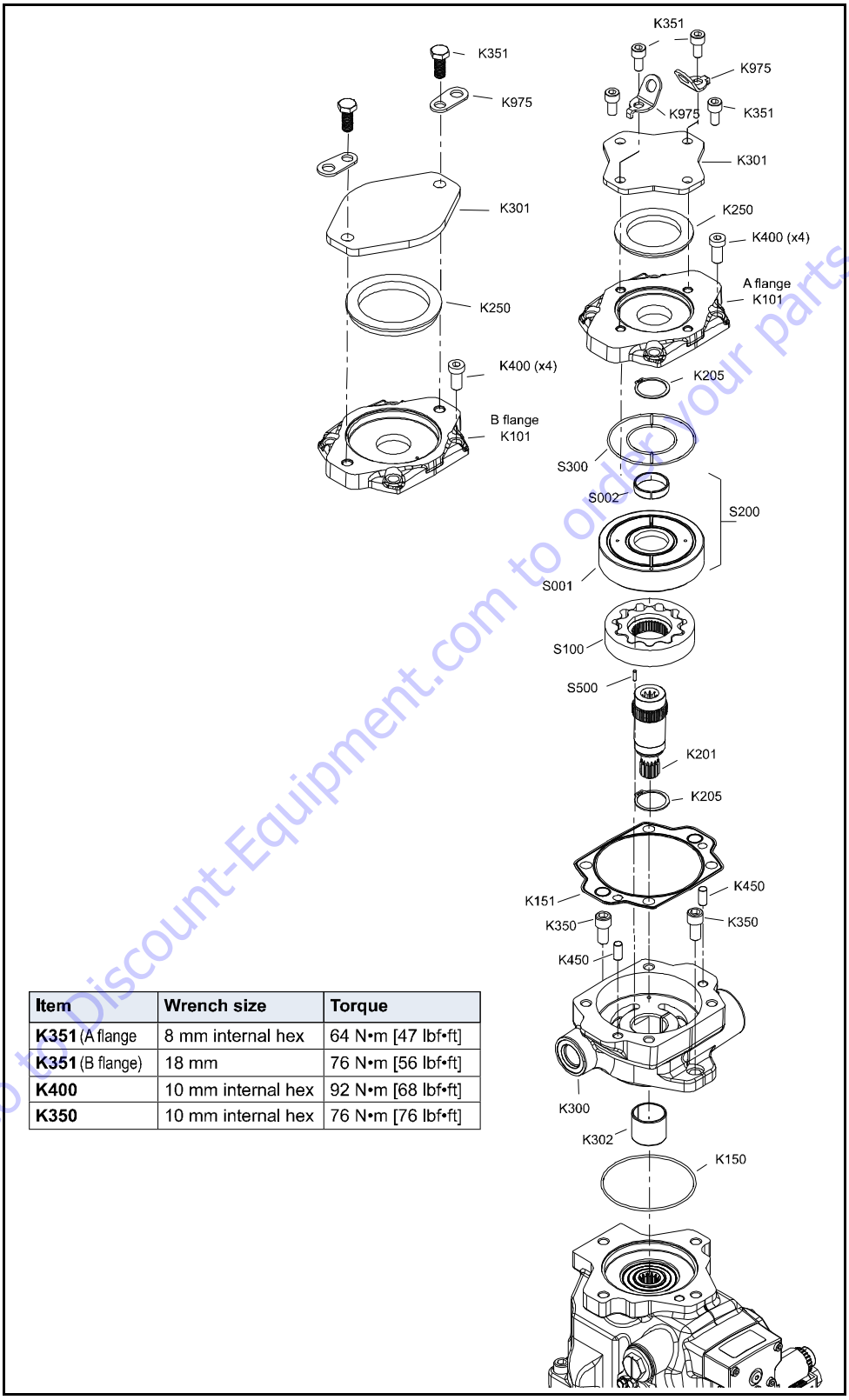
1. Remove screws (K351), and hangers (K975).
2. Remove running cover (K301). Remove and discard seal ring (K250).
3. Using a 10 mm internal hex, remove screws (K400). Remove cover (K101).
4. Remove charge pump assembly with shaft.

***NOTE:*** *Note position of alignment pin (S500) in housing. Alignment pin position will change for clockwise or counter-clockwise rotation.*

5. Remove and discard seal (S300).
6. Using a snap ring pliers, remove two clips (K205).
7. Remove geroter cover (S200). Remove geroter assembly (S100).
8. Remove and discard gasket (K151). Remove alignment pins (K450).
9. If it is necessary to remove housing (K300), use a 10 mm internal hex to remove screws (K350).
10. Remove housing (K300).
11. Remove and discard seal (K150).

### INSPECTION

1. Inspect all machined surfaces. If you find any nicks or scratches, replace the component.
2. Inspect geroter and cover for wear or damage. If wear or damage is found, replace geroter kit.
3. Inspect shaft for wear or damage. If found, replace shaft.
4. Inspect journal bearings in aux pad and housing. If worn or damaged, replace journal bearings or aux pad or housing assembly.



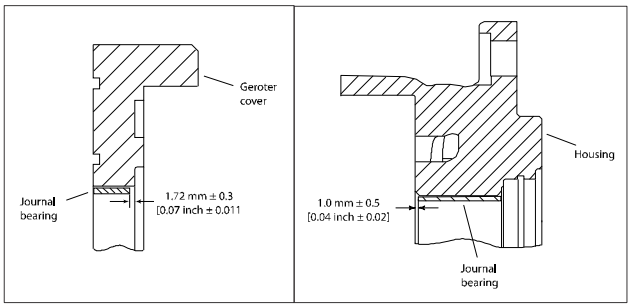

| Item | Wrench size | Torque |
|---|---|---|
| **K351** (A flange | 8 mm internal hex | 64 N•m [47 lbf•ft] |
| **K351** (B flange) | 18 mm | 76 N•m [56 lbf•ft] |
| **K400** | 10 mm internal hex | 92 N•m [68 lbf•ft] |
| **K350** | 10 mm internal hex | 76 N•m [76 lbf•ft] |



**Figure 5-135. Charge Pump**

### REPLACING CHARGE PUMP JOURNAL BEARINGS

Use a suitable press to remove and replace the journal bearings. Refer to the drawings below for installation dimensions.




### ASSEMBLY

1. Lubricate and install new seal (K150).
2. Install housing (K300). Install screws (K350). Using a 10 mm internal hex, torque screws per listing in table.
3. Install alignment pins (K450). Install new gasket (K151).
4. Lubricate and reassemble charge pump assembly [shaft (K201), pin (S500), geroter (S100), cover (S200), two clips (K205)].
5. Install charge pump assembly into housing in original position.
6. Lubricate and install seal (S300).
7. Install aux pad (K101).
8. Using a 10 mm internal hex, install screws (K400). Torque screws per listing in table.
9. Lubricate and install seal (K250). Install running cover (K301).
10. Install screws (K351) and brackets (K975). Torque screws per listing in the table.

## Charge Check / HPRV

The high pressure relief and charge check valve assembly may be removed for cleaning and replacement of the O-rings. These valves are factory set and are not field adjustable. Refer to the pump model code for the factory setting when ordering replacements.

### REMOVAL

1. Using an 8 mm internal hex wrench, remove the valve seat plugs (K007).
2. Carefully lift the valve (H002) and spring (H003) assemblies from the center section using a magnet.

### INSPECTION

1. Inspect the valves and mating seats in the valve seat plugs (K007) for damage or foreign material.

### REASSEMBLY

1. Lubricate and install new O-rings (K008, K010) and backup ring (K009) on valve seat plug (K007).
2. Verify that the conical springs (H003) are properly retained on the check relief valves (H002). Install the valve assemblies into the center section. Ensure each valve assembly moves freely in its bore.
3. Install the valve seat plugs into the center section and torque to 80 Nm [59.lbft].
4. Operate machine through full range of controls to ensure proper operation. Check for leaks.

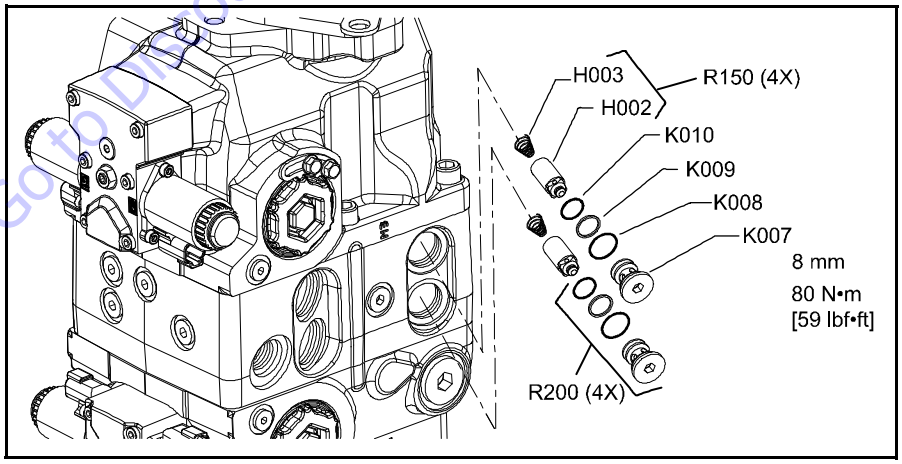



**Figure 5-136. Charge Check / HPRV**

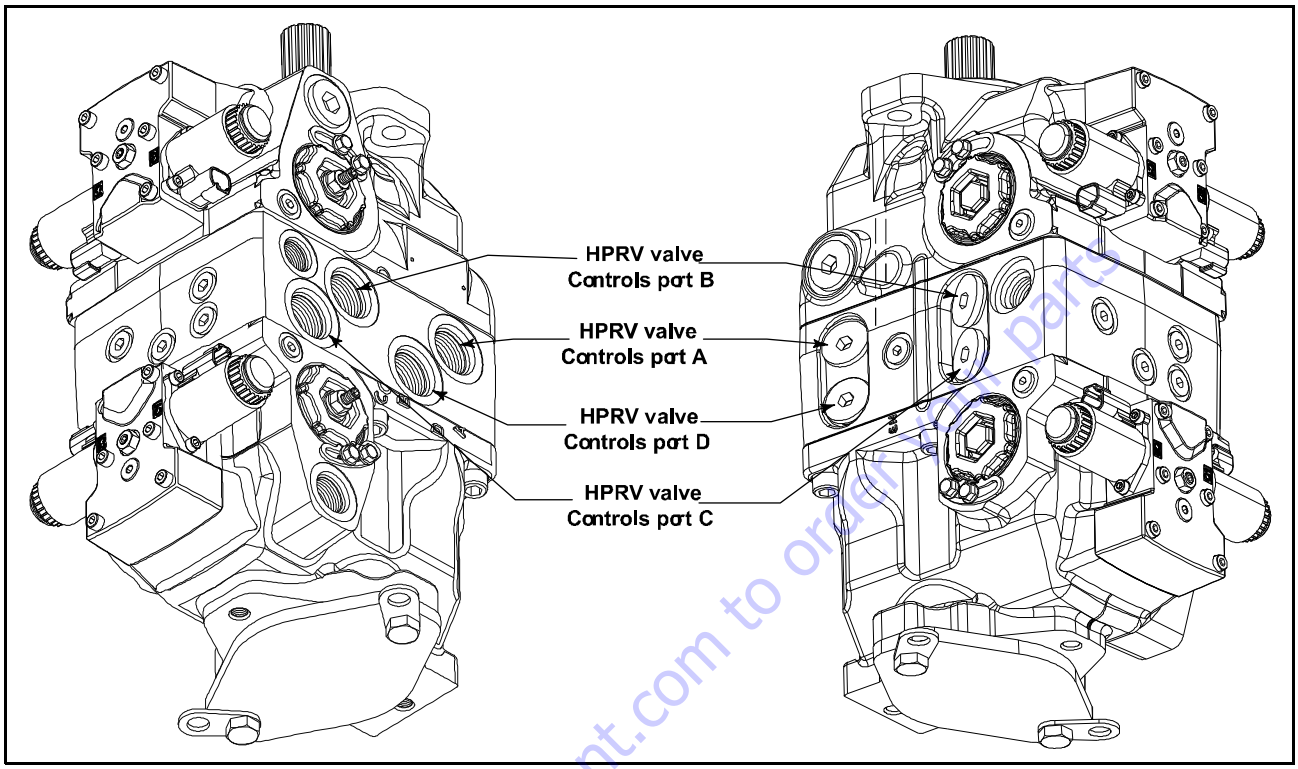



**Figure 5-137. Charge Check / HPRV**

## Charge Pressure Relief Valve

Replace the charge pressure relief valve (V10-1) or (V10-2) as a complete unit. Do not attempt to repair the internal components of the valve.

### REMOVAL

1. Using a 27 mm (V10-1) or a 1 in (V10-2) wrench, remove the charge pressure relief valve. Discard the O-rings (V10A).

### INSPECTION

1. Inspect the sealing surfaces of the pump and charge pressure relief valve for nicks or scratches, replace components as necessary.

### REASSEMBLY

1. Lubricate and install new O-rings (V10A).
2. Install the charge pressure relief valve (V10). Torque to 52 Nm [38 lbft].
3. Operate vehicle/machine through full range of controls to ensure proper operation.

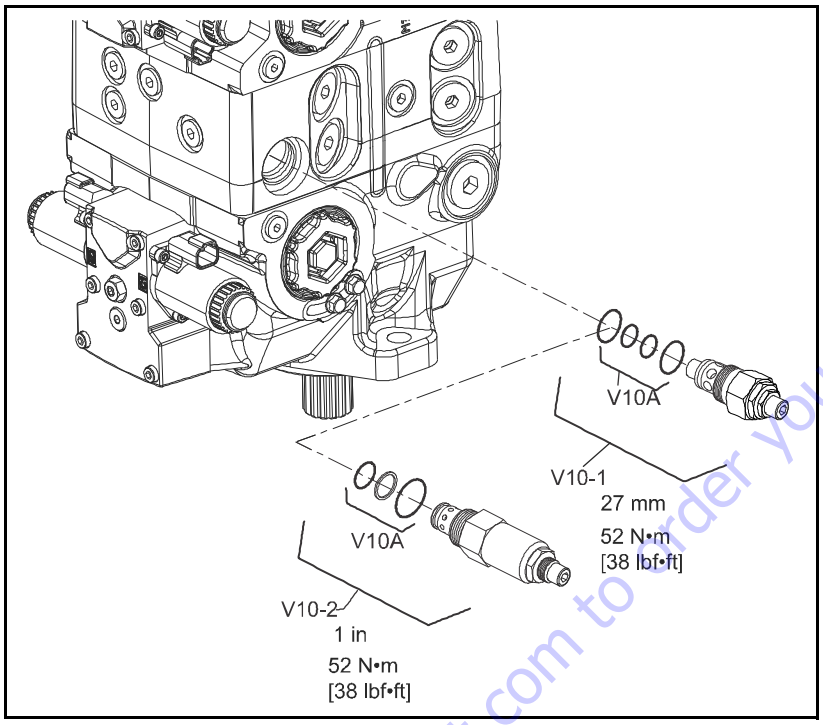



**Figure 5-138. Charge Pressure Relief Valve**

## Control Cutoff Valve

Replace the control cutoff valve as a complete unit. Do not attempt to repair the internal components of the valve.

### REMOVAL

1. Disconnect the coil from the vehicle/machine wire harness.
2. Using a 24 mm hex wrench, remove the control cutoff valve coil nut (G30). Remove the coil (G20).
3. Use a 1 1/16 in hex wrench to remove the control cutoff valve (G10). Remove and discard the O-rings and backup rings (G10A).

### INSPECTION

1. Inspect the sealing surfaces of the pump and control cutoff valve for nicks or scratches. Replace components as necessary.

### REASSEMBLY

1. Lubricate and install new O-rings (G10A) onto the valve.
2. Install the control cutoff valve (G10). Torque to 46 Nm [34 lbft]. Slide the coil (G20) onto the valve.
3. Install the coil nut (G30). Torque to 9 Nm [7.lbft]. Do not overtorque.
4. Operate vehicle/machine through full range of controls to ensure proper operation

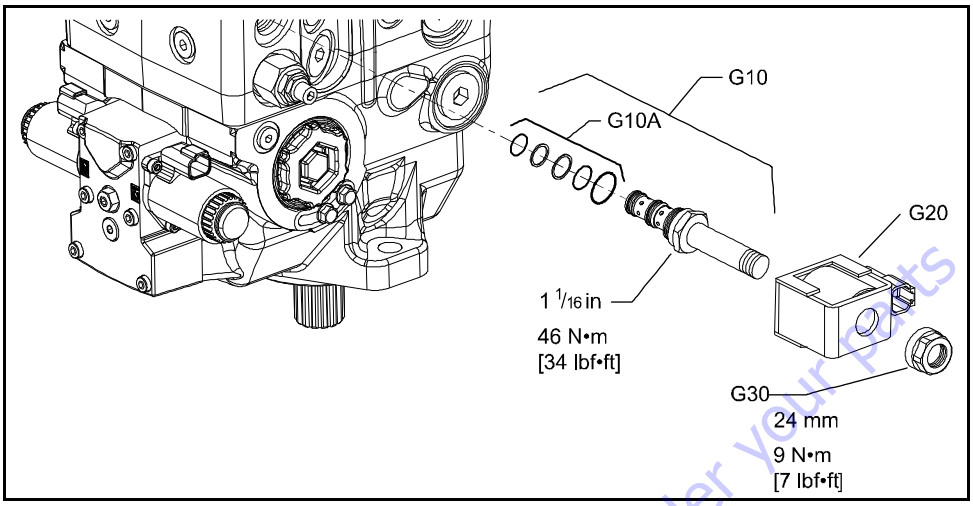



**Figure 5-139. Control Cutoff Valve**



**Table 5-41. Fastener Size and Torque Chart**

| Item | Fastener | Wrench size | Torque |
|---|---|---|---|
| D015 | Neutral adjust screw | 4 mm internal hex | NA |
| D050 | Control coil mounting screw | 4 mm internal hex | 8 Nm [5.9 lbft] |
| D060 | Neutral adjust locking nut | 13 mm hex | 10 Nm [7 lbft] |
| D200 | Swash plate feedback pin (not shown) | 13 mm hex | 25 Nm [18.4 lbft] |
| D250 | Electric control mounting screw | 5 mm internal hex | 13 Nm [9.5 lbft] |
| E350 | Servo cylinder locking screw | 10 mm hex | 14.5 Nm [11 lbft] |
| G10 | Control cutoff valve | 1 1/16 in hex | 45 Nm [33 lbft] |
| G10B | Control cutoff valve coil nut | 24 mm hex | 9 Nm [7 lbft] |
| K007 | Charge check / HPRV | 8 mm internal hex | 80 Nm [60 lbft] |
| K350 | A pad cover mounting screw | 17 mm hex | 70 Nm [52 lbft] |
| | B pad cover mounting screw | 8 mm hex | 111 Nm [82 lbft] |
| V10-1 | Charge relief valve | 27 mm hex | 52 Nm [38 lbft] |
| V10-2 | Charge relief valve | 1 in hex | 52 Nm [38 lbft] |

**Table 5-42. Plug Size and Torque Chart**

| Item | O-ring plug | Wrench size | Torque |
|---|---|---|---|
| B015 | 7/16 - 20 | 3/16 internal hex | 20 Nm [15 lbft] |
| B020 | 1-1/16 - 12 | 9/16 internal hex | 48 Nm [35 lbft] |
| D065 | 7/16 - 20 | 3/16 internal hex | 12 Nm [9 lbft] |
| G250 | 9/16 - 18 | 1/4 internal hex (hardened plug) | 45 Nm [33 lbft] |

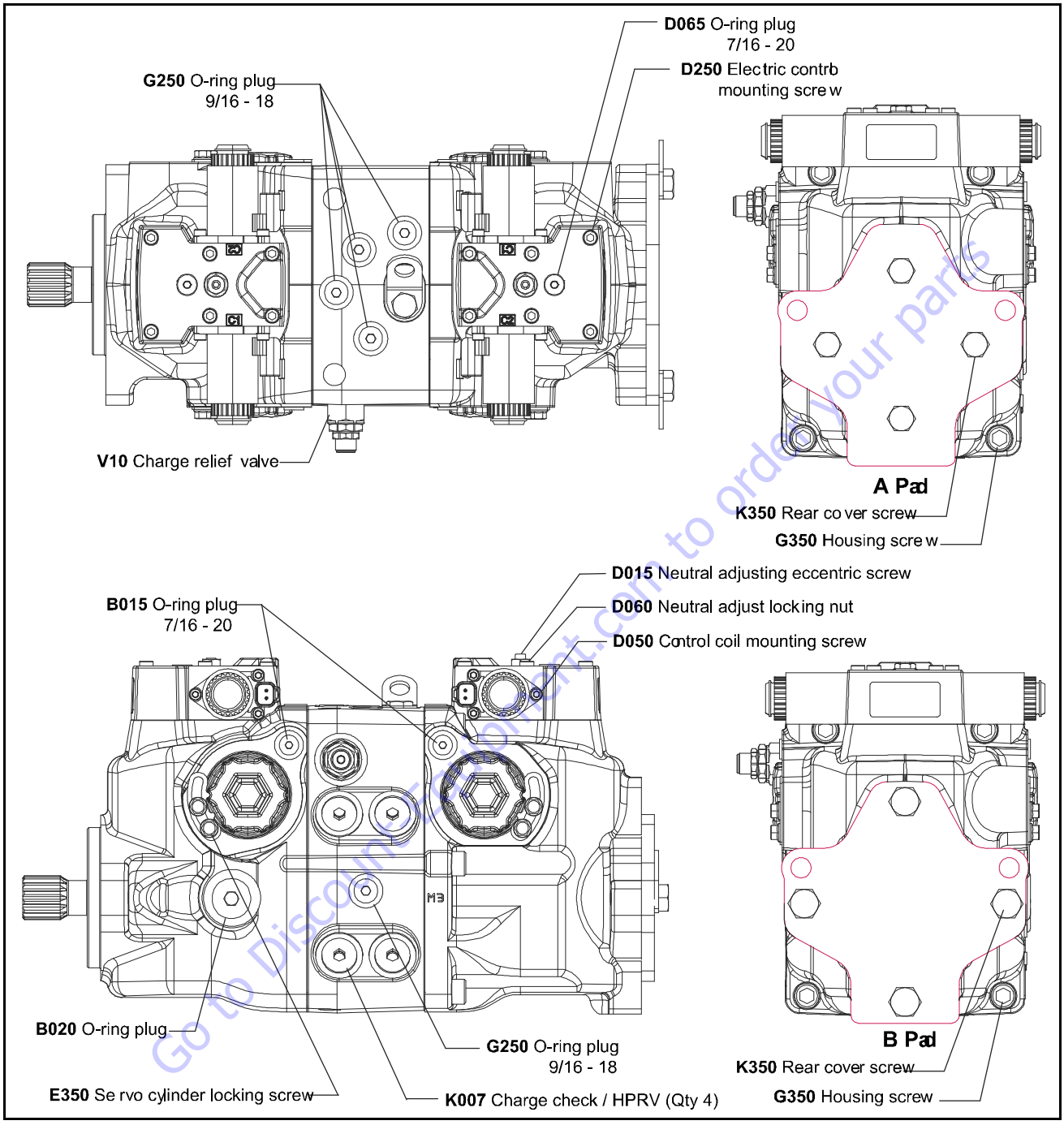
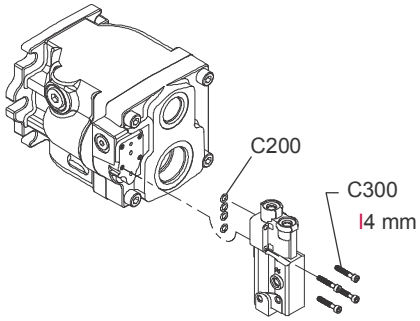



**Figure 5-140. Fastener and Plug Locations**

## 5.7 FUNCTION PUMP

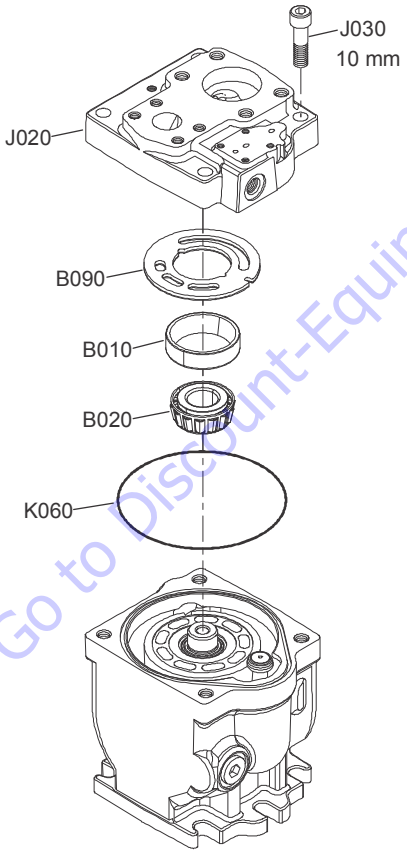
### Disassembly

1. Remove the control from the endcap by removing the 4 control bolts (C300), using a 4 mm internal hex wrench.




2. Remove and discard the 4 O-rings (C200).

3. Remove the 4 endcap screws (J030) using a 10 mm internal hex wrench.



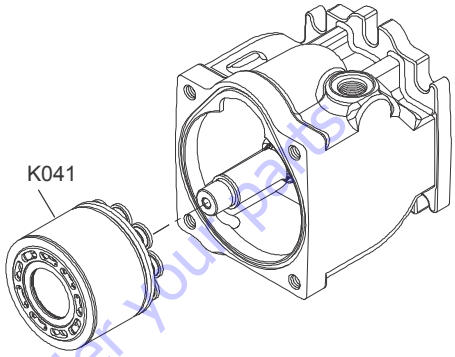

4. Carefully remove the endcap (J020). Prevent the valve (B090) plate from falling off.

5. Place the endcap and valve plate in a clean area, protecting them from contamination.

6. Remove the bearing cup (B010), bearing cone (B020) and housing O-ring (K060). Discard the O-ring.

7. Tilt the housing on its side to allow fluid to drain.

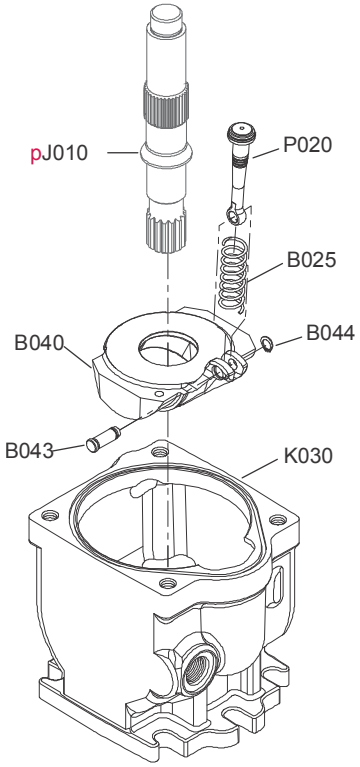
8. Remove the cylinder block kit while holding onto the front shaft.




9. Set cylinder block on a clean dry surface.

10. Rotate pump back to a position so that the shaft is pointing down.

11. Pull the shaft (J010) from the shaft seal.

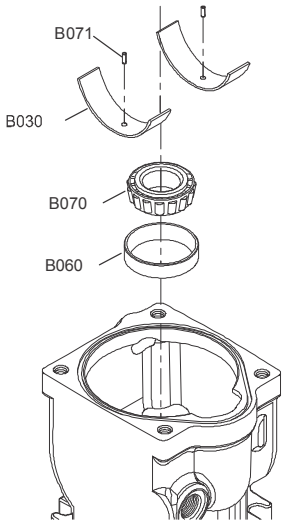



12. Compress the bias spring (B025) and rotate the servo piston assembly (P020) towards the swashplate (B040).

13. Lift the swashplate/servo piston assembly up at an angle and remove it from the housing.

**14.** Remove the servo piston (P020) and bias spring (B025) from the swashplate by removing the clevis pin (B043) and snap ring (B044). Discard the snap ring.

**15.** Pull to remove the front tapered roller bearing cup (B060) and cone (B070).



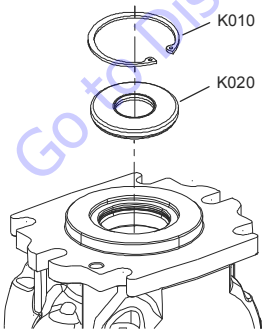

**16.** Examine the cradle bearings (B030) to determine if they need replacement.

***NOTE:*** *Removing the pins (B071) will likely damage the cradle bearings, so make sure you have replacement bearings before you remove them.*

**17.** If cradle bearings need replacing, remove the 2 pins (B071) holding the cradle bearings, and then remove the cradle bearings. Note the location and orientation of the bearings for re-installation.

**18.** Orient the housing with the flange facing up.

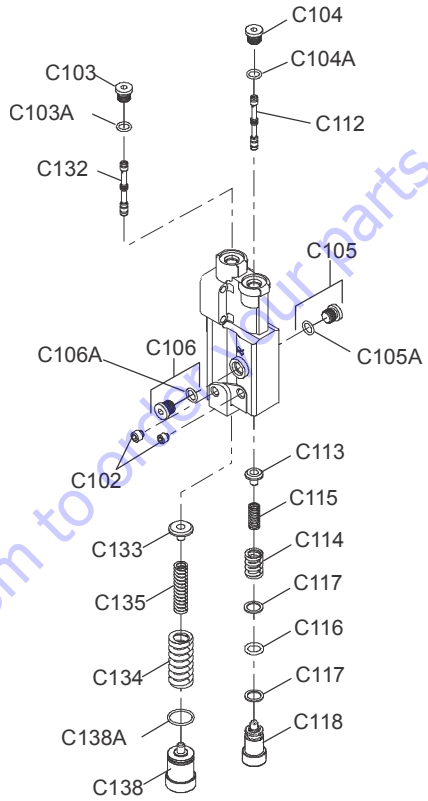
**19.** Using snap-ring pliers, remove the snap ring (K010).




**20.** Carefully pry out the shaft seal (K020).

If you are unable to pull the shaft seal out, try to push the seal out by going through the inside of the housing.

**21.** Remove the 4 plugs (C103, C104, C105, C106) and their O-rings (C103A, C104A, C105A, C106A). Discard the O-rings. Remove the 2 set screws (C102). Remove the spools (C112, C132). Note which bore each spool came out of. Also note the orientation of each spool for reinsertion. There may be differences in reinserting into the same bore.

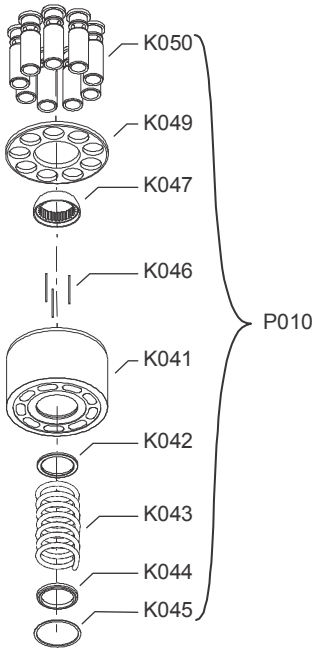



**22.** Remove the adjusting screw (C138) and the O-ring (C138A). Discard the O-ring. Remove the springs (C134, C135) and spring guide (C133).

**23.** Remove the adjusting screw (C118), O-ring (C116) and 2 backup rings (C117). Discard the O-ring and backup rings. Remove the springs (C114, C115) and spring guide (C113).

**24.** Pull to remove the slipper retainer (K049) with the pistons (K050) from the cylinder kit.

***NOTE:*** *The pistons are not selectively fitted, however units with high hourly usage may develop wear patterns. Number the pistons and bores for reassembly if they are to be reused.*




**25.** Remove the ball guide (K047).

**26.** Remove the 3 pins (K046).

***NOTE:*** *Most repairs do not require block spring removal. Perform this procedure only if you suspect problems with the block spring.*

**27.** Turn the block over. Using a press, apply pressure on the block spring washer (K044) to compress the block spring (K043). Compress the spring enough to safely remove the spiral retaining ring (K045). While maintaining pressure, unwind the spiral retaining ring. Carefully release the pressure and remove the outer block spring washer, block spring, and inner block spring washer (K042) from the cylinder block.

**⚠ WARNING**

**RISK OF PERSONAL INJURY: COMPRESSING THE BLOCK SPRING REQUIRES ABOUT 350 TO 400 N [80 TO 90.LBF]. USE A PRESS SUFFICIENT TO MAINTAIN THIS FORCE WITH REASONABLE EFFORT. ENSURE THE SPRING IS SECURE BEFORE ATTEMPTING TO REMOVE. THE SPIRAL RETAINING RING. RELEASE THE PRESSURE SLOWLY AFTER THE RETAINING.RING IS REMOVED.**

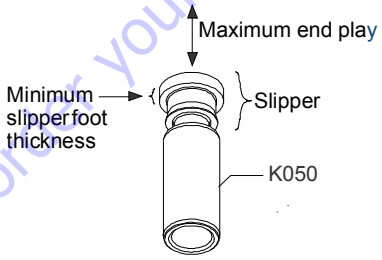
## Inspection

After disassembly, wash all parts (including the end-cap and housing) thoroughly with clean solvent and allow to air dry. Blow out oil passages in the housing and endcap with compressed air. Conduct inspection in a clean area and keep all parts free from contamination. Clean and dry parts again after any rework or resurfacing.

### PISTONS AND SLIPPERS

Inspect the pistons for damage and discoloration. Discolored pistons may indicate excessive heat; do not reuse.

Inspect the running surface of the slippers. Replace any piston assemblies with scored or excessively rounded slipper edges. Measure the slipper foot thickness. Replace any piston assemblies with excessively worn slippers. Check the slipper axial end-play. Replace any piston assemblies with excessive end-play.

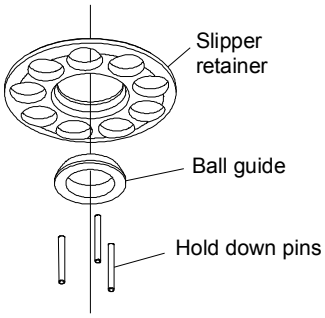



Minimum slipper foot thickness and maximum axial end-play are given in the table below.

| J Frame | |
|---|---|
| Slipperfoot thickness | 3.23 mm [0.127 in] |
| Piston/slipper end play | 0.05 mm [0.002 in] |

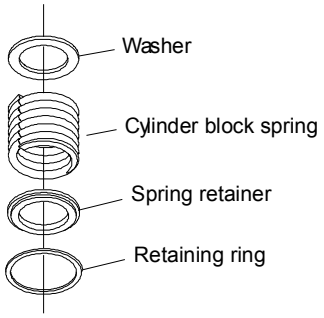
### BALL GUIDE, SLIPPER RETAINER, AND HOLD-DOWN PINS

The ball guide should be free of nicks and scratches, and should not be excessively scored. Examine for discoloration that may indicate excessive heat or lack of lubrication. The slipper retainer should be flat, and slippers should fit in the retainer with minimal side play. Place the hold-down pins on a flat surface and roll them to make sure they are straight. Discard and replace any damaged parts.



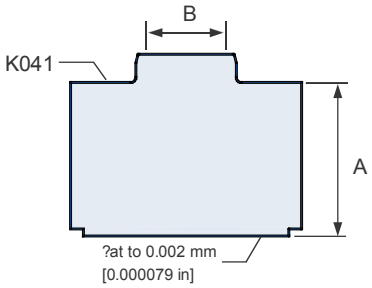
### BLOCK SPRING, AND WASHERS

If cylinder kit was fully dissembled, visual inspection of the cylinder block, spring, and washers should indicate minimal wear. Replace if cracks or other damage is present.




### CYLINDER BLOCK

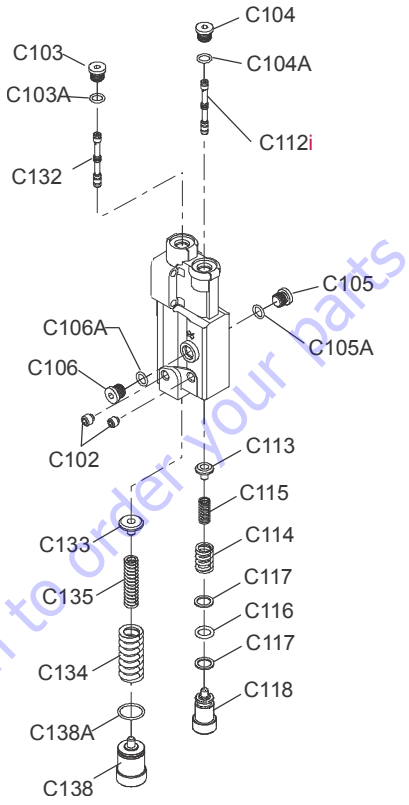
Examine the running face of the cylinder block. The surface should be smooth and free of nicks and burrs. Ensure that no scratches or grooves exist; these may drastically reduce output flow.




| J Frame | 45-60 cc | 65-75 cc |
|---|---|---|
| Minimum cylinder block height (A) | 62.25 mm [2.45 in] | |
| Maximum block bore diameter (B) | 19.8 mm [0.785 in] | 21.57 mm [0.85 in] |

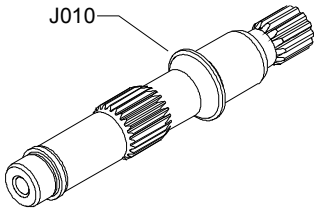
### CONTROL

Carefully examine the plug(s) for signs of wear. Also check the small tip of the plug(s) for heavy wear and replace if necessary. Inspect each spool's springs to make sure they are intact. Check the inside and outside surfaces of the springs for wear and replace if necessary. Check the spool's outside diameter for scratches and / or burrs. Clean and coat all spools, bores, and seals with a light coating of hydraulic oil.



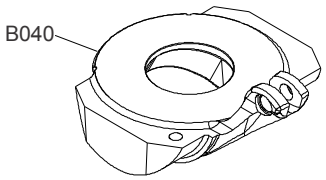

### INPUT SHAFT

Check to see that the shaft (J010) and its splines are straight and free of damage or heavy wear. Inspect the shaft surface where it meets the shaft seal. Replace the shaft if a groove exists at the sealing land surface that may let dirt into or hydraulic fluid out of the unit. Clean the sealing area with a nonabrasive material if necessary. Lubricate the shaft with a light coat of hydraulic fluid.



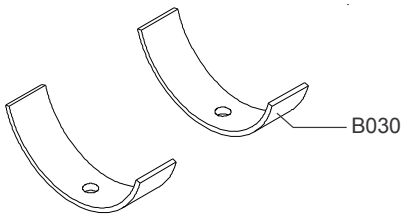
### SWASHPLATE

Carefully inspect each surface of the swashplate for wear. All swashplate surfaces should be smooth. Inspect the swashplate's slipper running surface for damage and brass transfer. Excessive brass transfer from slippers may indicate that the slippers should be replaced. Finally, check the swashplate bearing journal for scratches. Replace swashplate if necessary.




### JOURNAL BEARINGS

Inspect the journal bearings for damage or excessive wear. Replace journal bearings if scratched, warped, or excessively worn. The polymer wear layer must be smooth and intact.

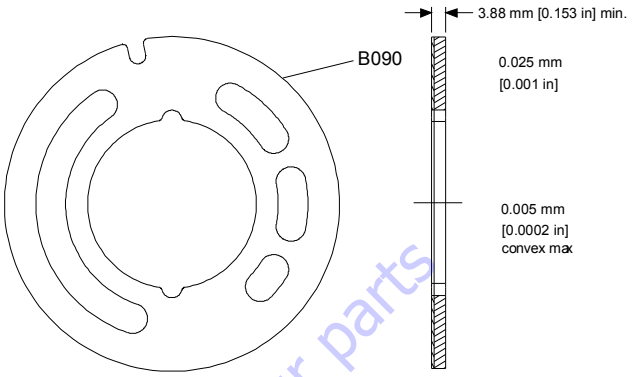



### VALVE PLATE

Inspect the valve plate for scratches and grooves. Check the plate for evidence of any cavitation along the running face of the valve plate. If pitting from cavitation exists, replace the valve plate. Check for excess wear on the brass running face. If any discoloration or burn marks are observed, replace the valve plate.

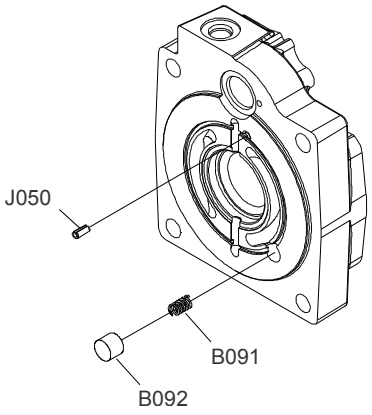
Run a fingernail or pencil tip across the diameter of the sealing land surface (see illustration). No deep or outstanding grooves should be felt, as these may decrease pump flow. Lap or replace if grooves or nicks are present. Inspect the mating surfaces of the endcap and valve plate for any possible contamination; even a few thousandths of an inch may affect pump operation.

Measure the thickness of the valve plate. Ensure that valve plate parallelism is equal to or less than 0.025 mm [0.001 in]. Appearance should be flat and smooth on both the running face and the bottom surface. The valve plate should be flat to 0.005 mm [0.0002.in] convex. A magnetic particle inspection is recommended to detect cracks. The valve plate must be replaced if any cracks exist.



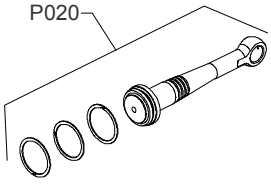

### ENDCAP

Inspect the endcap. Remove the check valve (B092) to expose the spring (B091). Check and record orientation of the timing pin (J050) The split in the timing pin should be facing into or out of the slot in the valve plate. Inspect the check valve for wear on its sealing face and replace if necessary. Make sure the spring is undamaged. Replace any components if excess wear is present.



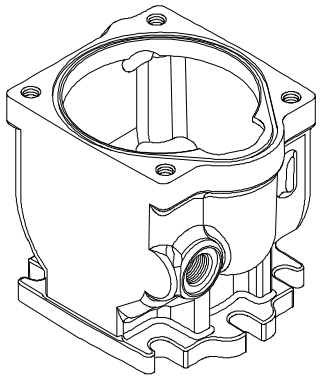

### SERVO PISTON

Check the servo piston assembly (P020) for any obvious wear or damage. Check the corresponding endcap bore for galling or excessive wear. Discard the piston if damaged. Replace the servo piston-rings.



### HOUSING

Inspect the housing to ensure that it is clean and free of foreign material. Inspect the swashplate bearing surfaces, and endcap mating surfaces.

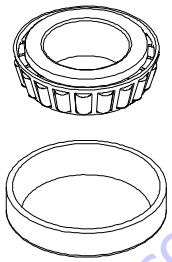


### SHAFT BEARING KITS

The tapered roller bearing kit consists of a cup and cone. Make sure the cup and cone are free of excessive wear or contamination. Rotate the bearings to check for smoothness. If a contaminated bearing is suspected, clean with a solvent and lubricate with hydraulic fluid.

***NOTE:*** *Replace the bearing if the problem is not remedied by cleaning.*

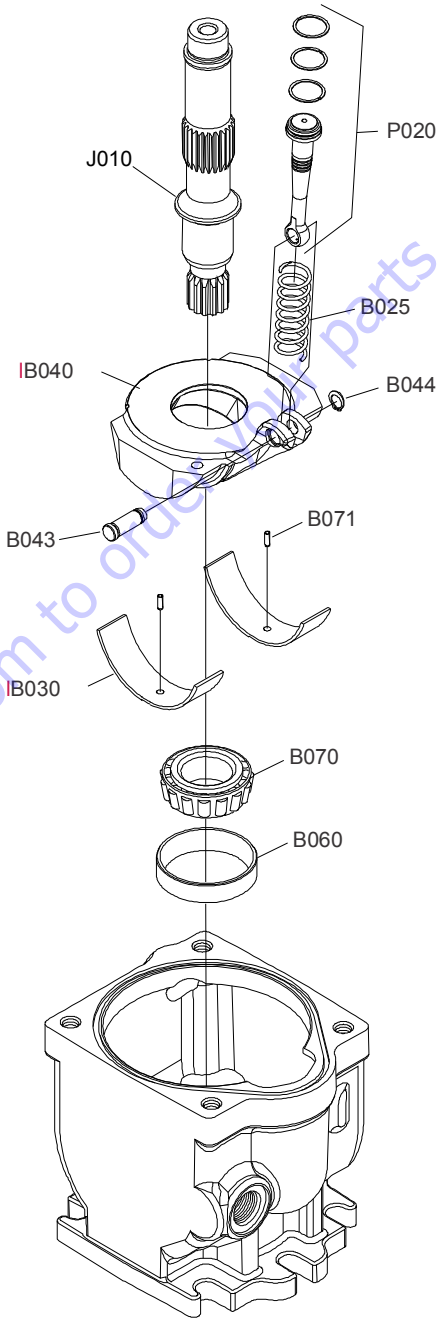
Inspect for uneven wear. If abnormal wear is found, replace the bearing kit.



## Assembly

1. Coat the journal bearings (B030) with hydraulic fluid and install them into the pump housing. Punch in retaining pins (B071) a minimum of 0.5 mm [0.002 in] below the bearing surface.

***NOTE:*** *If journal bearings are reused, reinstall them in their original orientation and position.*




2. Reinstall shaft bearing cup (B060) and cone (B070). Before replacing the bias spring (B025), coat the curved surface of the swashplate with hydraulic fluid.

3. Reinstall the swashplate/servo piston/bias spring assembly in its original orientation in the housing. Rotate the servo piston perpendicular to the swashplate, and at the same time compress the bias spring to fit into housing pocket. Lubricate all sides of the servo piston and its respective bore liberally with hydraulic oil. Also, lubricate the flat face of the swashplate to prevent premature wear during start-up.

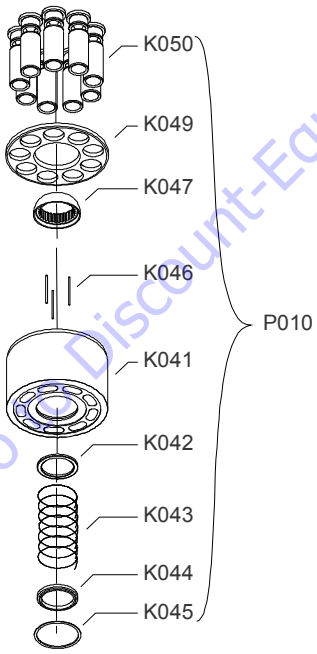
4. Insert the input shaft (J010) through the bearing into the housing. You may need to push on the servo piston to rotate the swashplate in order to put the shaft in properly.

5. Coat all parts with hydraulic fluid prior to reassembly.

**⚠ WARNING**

**COMPRESSING THE BLOCK SPRING REQUIRES ABOUT 350 TO 400 N [80 TO 90 LBF]. USE A PRESS SUFFICIENT TO MAINTAIN THIS FORCE WITH REASONABLE EFFORT. ENSURE THE SPRING IS SECURE BEFORE ATTEMPTING TO INSTALL.THE SPIRAL RETAINING RING. RELEASE THE PRESSURE SLOWLY AFTER THE RETAINING RING IS INSTALLED.**

6. Install the inner block spring washer (K042), block spring (K043), and outer washer (K044) into the cylinder block. Using a press, compress the block spring enough to expose the retaining ring groove. Wind the spiral retaining ring (K045) into the groove in the cylinder block.

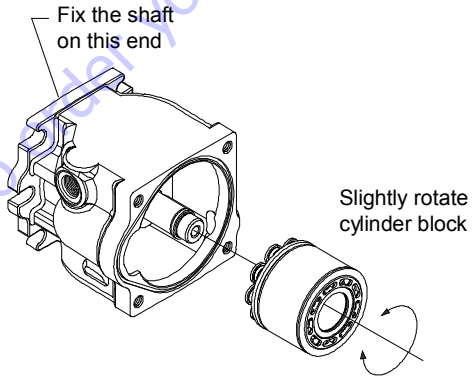



7. Turn the block over and install the hold-down pins (K046), and ball guide (K047) to the cylinder block.

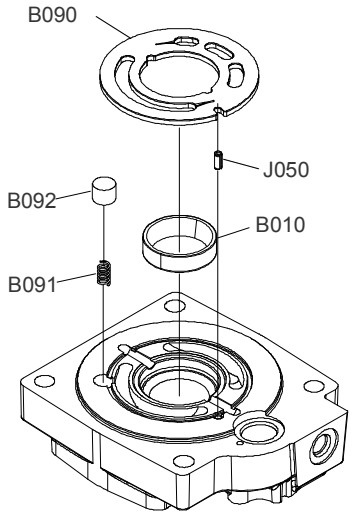
8. Install the pistons (K050) to the slipper retainer (K049). Install the piston/retainer assembly into the cylinder block. Ensure the concave surface of the retainer seats on the ball guide. If you're reusing the pistons, install them to the original block bores. Lubricate the pistons, slippers, retainer, and ball guide before assembly. Set the cylinder kit aside on a clean surface until needed.

***NOTE:*** *Be sure to install the slipper retainer so it mates correctly with the ball guide (concave side of the slipper retainer against the convex side of the ball guide).*

9. Set the pump on its side. Secure the end of the shaft with one hand and keep it horizontal. Insert the cylinder kit onto the shaft. While holding the shaft still, slightly rotate the cylinder block kit to help start the shaft splines over the ball guide and align it with the block splines. When the cylinder block kit slides completely over the shaft splines, reposition the unit with the flange facing downward.

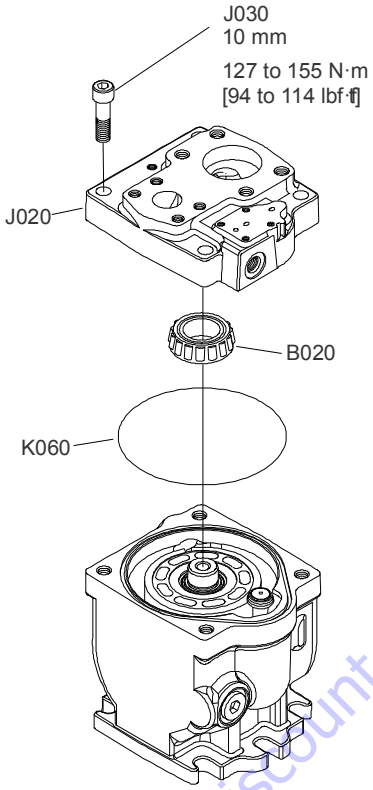



10. Clean the valve plate (B090) and endcap. Install the timing pin (J050) in the endcap and verify that it is properly oriented with the split facing into or out of the slot in the valve plate. The timing pin should be installed to 3.61 ? 0.25.mm [0.14.?.0.01 in] above the valve plate surface. Apply a liberal amount of assembly grease to the backside of the valve plate surface to hold it in position. Install the valve plate over the timing pin, check valve (B092), and bearing cup (B010).

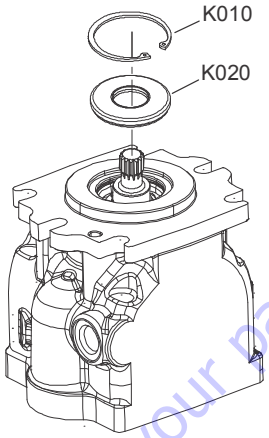


***NOTE:*** *To insure proper pump operation, it is extremely important to ensure that there is no contamination between the end-cap and valve plate.*

**11.** Install the bearing cone (B020) onto the shaft. Using assembly grease to hold the seal (K060), install the end-cap to the housing. Ensure that seals remain properly seated and are not pinched during assembly. With a 10 mm internal hex wrench, install and torque endcap screws at 127 to 155 Nm [94.to.114.lbft], using the criss cross pattern. Retorque the first screw to ensure proper torque retention.

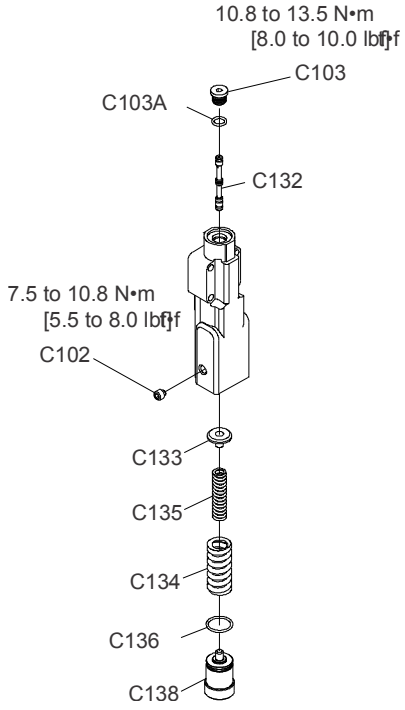



**12.** Lubricate the lip of the new shaft seal (K020) with clean hydraulic fluid. Place a protective sleeve over the shaft end to prevent damage to the seal during installation. Keeping the seal perpendicular to the shaft, press the new seal into the housing just far enough to clear the retaining ring groove. Install seal with the cupped side toward the shaft bearing. Do not damage the seal during installation. Using the appropriate snap ring pliers, install the seal retaining ring (K010). Remove the installation sleeve.

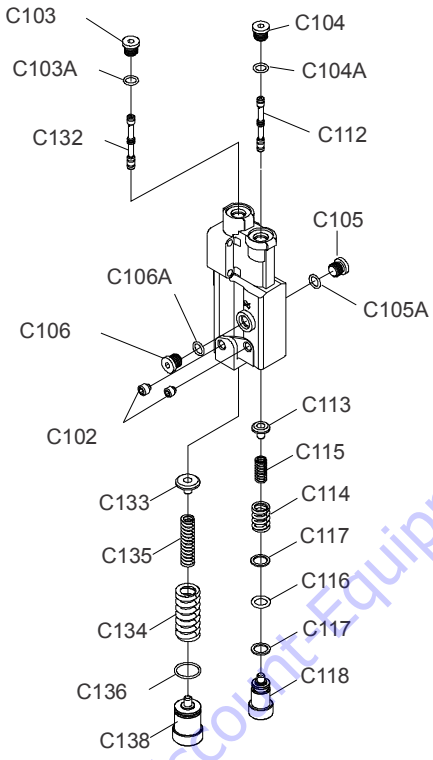



**13.** Clean all control parts and cover with a light coating of hydraulic fluid prior to reassembly.

**14.** Install the spherical end of the PC spool (C132) into the PC bore (refer to illustration). Install the PC plug (C103) using a new O-ring (C103A). Torque at 10.8 to 13.5 Nm [8.to.10.lbft]. Place the two PC springs (C134, C135) onto the PC spring guide (C133) and install into the PC bore. Place a new O-ring onto the PC plug and install it so that it sits one turn below the surface of the control housing. Install and tighten set screw (C102) at 7.5 to 10.8 Nm [5.5 to 8.0 lbft] to retain the adjusting plug.

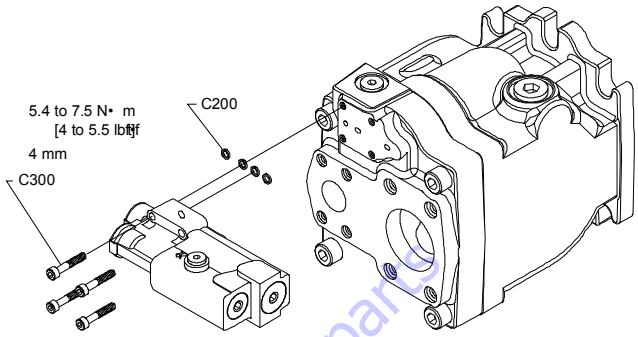


**15.** Hold the control in a horizontal position. Install the spherical end of the LS spool (C112) into the LS bore (see illustration). Using a new O-ring, install the LS plug (C104), torque at 10.8 to 13.5 Nm [8 to 10 lbft]. Place the 2 LS springs (C114, C115) onto the LS spring guide (C113) and install into the LS bore. Place a new O-ring (C116) and backup rings (C117) onto the LS adjustment screw (C118). Install the LS plug assembly so that it sits one turn below the surface of the control housing. Install and tighten set screw (C102) at 7.5 to 10.8 Nm [5.5.to 8.0 lbft]. Also, install the plugs (C105, C106) with new O-rings. Torque the plugs at 10.8 to 13.5 Nm [8 to 10 lbft].




***NOTE:*** *PC and LS spools need to be adjusted to proper setting according to tag nomenclature.*

**16.** Using petroleum jelly to retain them, install 4 new seal rings (C200) in the recesses on the control housing. Install the control assembly onto the endcap using the 4 screws (C300). Torque at 5.4 to 7.5 Nm [4.0 to 5.5 lbft] using a criss cross pattern and retorque the first screw to ensure proper torque retention.



## 5.8 GEAR PUMP

### Disassembly

Prior to proceeding it may be necessary to prepare some subassemblies separately.

The details for preparing each subassembly are given in the following section.

Also, some general recommendations are given below.

#### CLEANLINESS

Cleanliness is a primary factor for reliable pump performance. Wash the outside of the pump thoroughly before disassembly and all pieces prior to assembly. Cleaning parts with clean shop solvent and air drying is usually adequate.

#### LUBRICATION OF MOVING PARTS

During assembly, it is imperative to provide lubrication with clean hydraulic oil to all the running parts of the pump.

It is also necessary to coat the seals with grease. The absence of lubrication during assembly can cause the unit to seize after a few minutes of running.

#### CARE OF SURFACE TREATMENT

Be careful when handling all the internal surfaces, especially bearings, gears, and body faces. Do not touch or score them with metal tools or cutting edges.

#### MARKING THE PARTS

Mark the parts before completely disassembling a pump. The marks allow components to be reassembled in the same relative position. This action should be applied to the body, bearings, and gears. Scribing, bluing, or using a felt tip pen to mark the outside of the body on the inlet side is suggested to indicate the relative position of the front flange and the rear cover to the body. Mark the bearing blocks also on the inlet side and the gears position relative to each other. DO NOT scribe internal surfaces.

#### PROCEDURE

**1.** Clamp the unit.

Clamp the unit in a vice from the flange side.

Make sure the vice jaws are clean and have smooth surfaces to prevent damage to the pump.

***NOTE:*** *Clamping the pump on the body is not recommended because serious damage to the surfaces, on which the ports are located, may occur.*

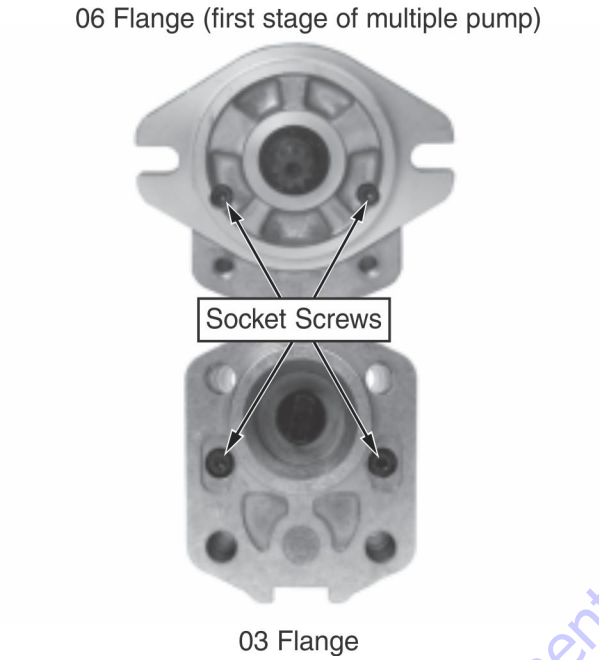
**2.** Remove capscrews. (Except Units with 03 Flange).

Use a 17 mm socket wrench and loosen the four capscrews on the cover. Next completely unscrew the capscrews and remove them.

Inspect the threads of the capscrews for damage.

**3.** Remove socket head capscrews. (03 Flange or Multiple Pump Stages Only).

Using a 4 mm internal hex wrench, loosen and remove the two small socket screws placed in the center of the cover. Repeat the same operation for the corresponding screws on the rear flange.




**4.** Remove front flange.

Place the pump on the table and slowly remove the front flange.

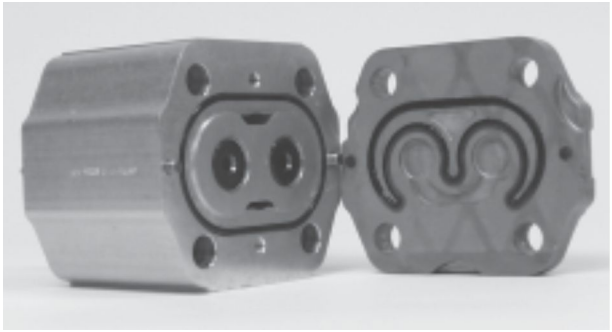
Be careful not to damage the shaft seal when removing the flange. Avoid contact of the shaft seal lips with key-way edges (in tapered and parallel shafts) or splined shaft teeth.

Inspect the front flange and seal area.

Clean with shop solvent, dry, and set aside.

**5.** Remove rear cover.

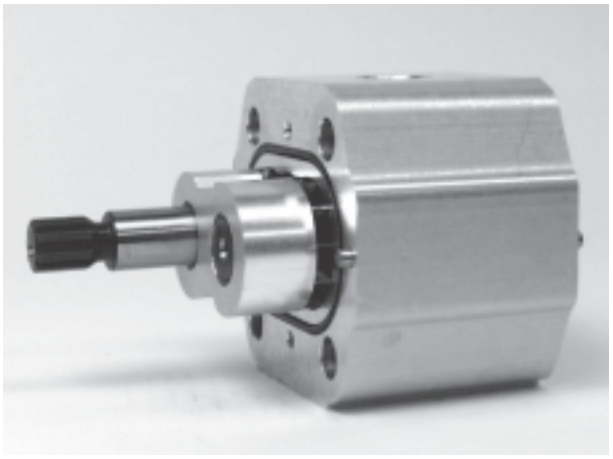
Remover rear cover. Clean with shop solvent, dry, and set aside. Visually inspect rear cover and seal area.



**6.** Remove bearing blocks and gears.

Place the pump on its side and carefully remove the bearing block and gear set. To accomplish this, hold the pump body and push with your fingers on the rear bearing block.

Mark the relative positions of the gear mesh (drive gear tooth to idler gear tooth) and the bearing blocks to the body so they can be reas?sembled in the same position.

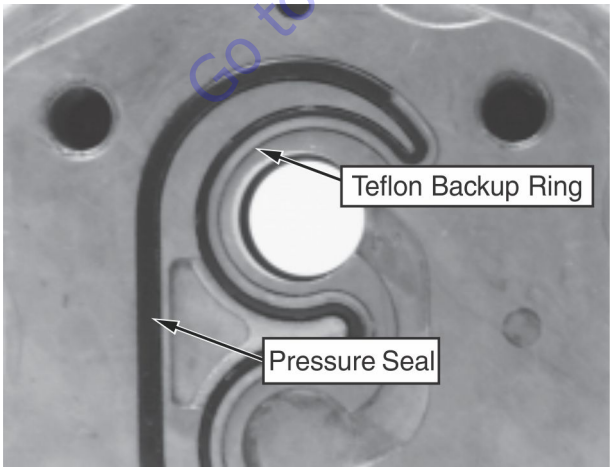


**7.** Remove pressure seals.

Check the seal quality. Replacement is recommended whenever there are burrs, evidence of extrusion, or marks caused by overheating. If the seals need to be replaced, carefully remove them from the flange cover, beginning with the backup ring and then the pressure seal.

Do not use tools with sharp edges to remove the seals, as damage to the cover can result.

After removal, dispose of damaged seals.

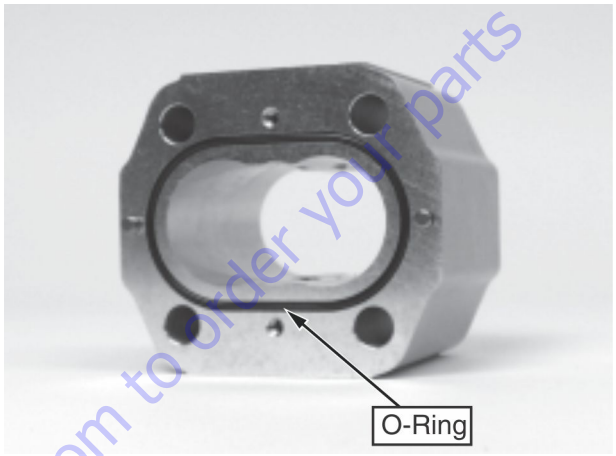



**8.** Remove Outer O-Ring Seal

Check the quality of this seal. If necessary, replace it. Follow the same removal recommenda?tions given in step 7.

After removal, discard the damaged seal.

Do not use tools with sharp edges to remove the seals, as damage to the cover can result.




**9.** Remove the snap ring.

Place the flange on the work surface. Using internal snap ring pliers, remove the snap ring.

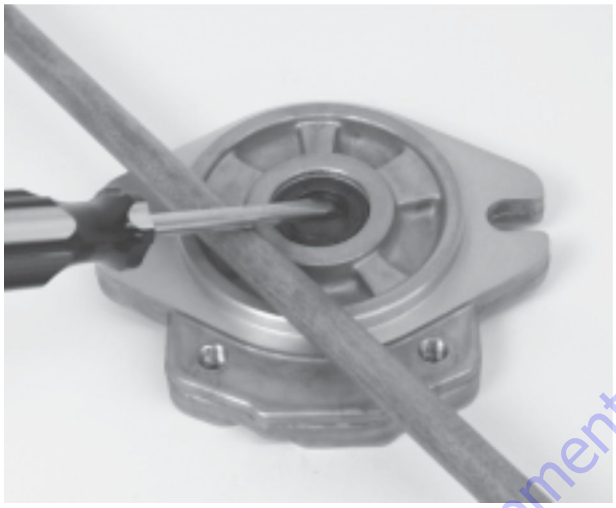
**10.** Remove the shaft seal.

Check the shaft seal quality and remove if necessary.

To remove, pry the bottom of the shaft seal and force it out while rotating the flange to lift it out evenly.

Do not use the flange pilot to gain leverage, damage may result. Use a plastic rod or wooden dowel as a fulcrum.

After removal, dispose of damaged seal.



## Assembly

**1.** Prepare the seals.

Have the entire seal kit available.

Lightly coat all seals with seal grease. The grease is needed to adhere the seals to their grooves.

Do not install dry seals.

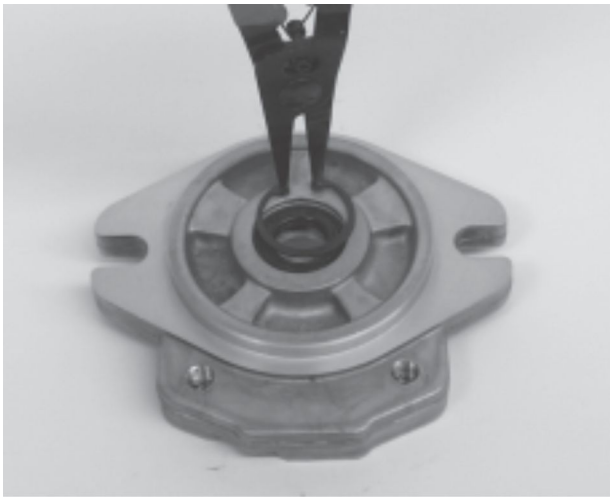
**2.** Install shaft seal into front flange.

Prepare the flange and shaft seal by lightly lubricating with grease.

Seat the seal in the flange by hand. Then, using the shaft seal installation tool, press the seal until the tool stops on the flange. This will insure the seal is inserted to the proper depth.

**3.** Install snap ring.

Install the snap ring using internal snap ring pliers. Ensure the snap ring fits securely in its groove. This is necessary to retain the shaft seal.

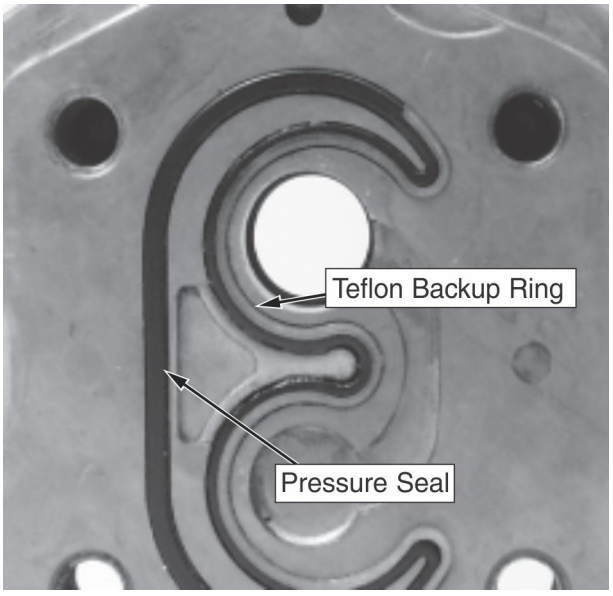


4. Install pressure seals.

   Prepare the pressure seals by lightly lubricating them with grease.

   Install pressure seals into the grooves on the front flange and rear cover. Then install the teflon backup ring.

   Ensure that the seals are located in the grooves, as shown.




5. Prepare the body.

   Clean the body.

   Inspect the internal and mating surfaces. Ensure the surfaces are free of burrs and scratches. Check both the bearing block mating surface and the cut-in path. The cut-in path should be no deeper than 0.1 mm (0.004 in).

6. Install outer seal.

   Prepare the outer seal by lightly lubricating with grease.

   Install outer seals in the grooves on both sides of the body.

**7.** Prepare the gears.

**⚠ CAUTION**

**THE GEAR SURFACES ARE SUPER-FINISHED. RESIDUE ON HANDS AND FINGERS MAY BE CORROSIVE TO THIS SURFACE. DO NOT TOUCH.**

Carefully clean the two gears. If the gears are new, wash them with shop solvent to remove any anticorrosive grease on the surfaces.

Inspect the journals and the flat faces on the top and bottom of the gears. Ensure these surfaces are free from burrs or scratches. If scratches or burrs are found, clean them with a flat stone and/or very fine emery paper. Rewash the gears after this operation.

**8.** Prepare the bearing blocks.

Clean the two bearing blocks.

Inspect the flat surfaces of the bearing blocks for burrs or scratches on the edges. If necessary, remove burrs with very fine emery paper. Then rewash the bearings.

Inspect the DU bushings for wear. There should be no bronze showing.

Using clean hydraulic oil, lubricate the internal and external surfaces of the bearing blocks.

**9.** Assemble the bearing blocks and gears.

Lubricate the journals and the gear faces.

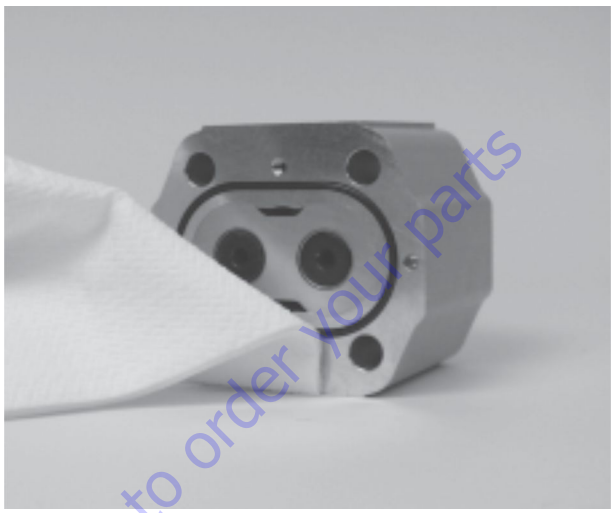
Assemble the bearing blocks and gears. Ensure that the recessed bearing faces are installed adjacent to the gear faces. Align all assembly marks made during disassembly. Ensure the front and rear bearing blocks occupy the same location with respect to the housing as before disassembly. Ensure that the relative position of the gear mesh is maintained as before disassembly. Misalignment of the gear teeth may increase operating noise.

**10.** Install the gear block assembly.

Install the bearing block and gear assembly into the body cavity. Align the assembly marks to ensure that the gear block assembly is installed with the same orientation as before disassembly.

**11.** Clean the mating surfaces.

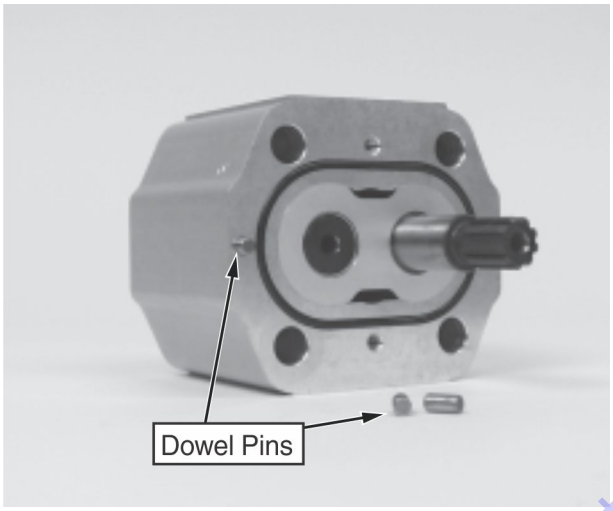
Remove any excess lubrication and grease from the mating surfaces of the pump body. Ensure that these surfaces are dry and free of contamination before moving on to the next step.

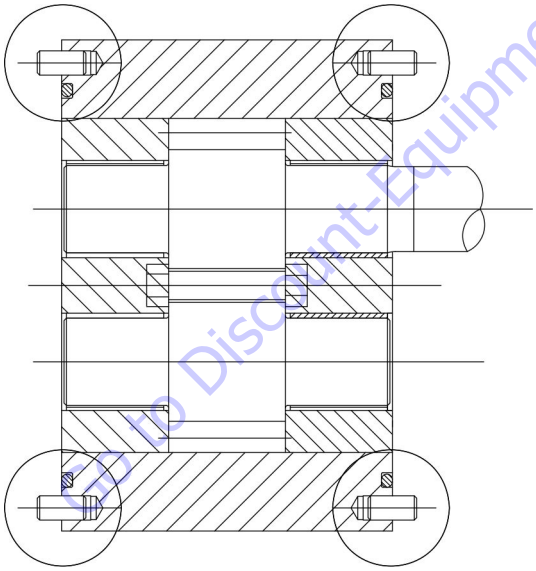


**12.** Install the dowel pins.

Install four 5 mm dowel pins into the proper cavities on both sides of the body (refer to the illustration). Swab the pins with assembly grease or petroleum jelly to retain them during assembly.

Do not install dowel pins to the rear cover or flange, as one of them may drop inside the pump during assembly.



**13.** Clean the mating surfaces.

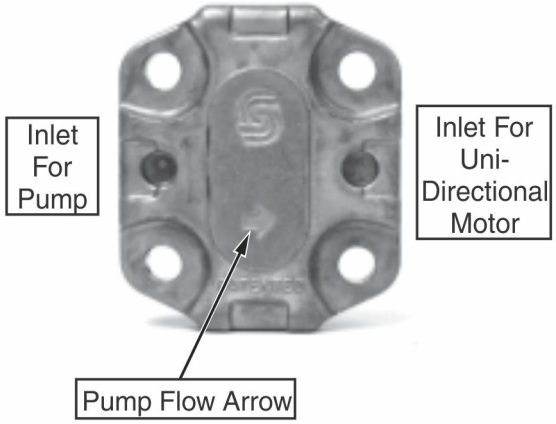
Remove any excess lubrication and grease from the mating surfaces of the front flange and rear cover. Ensure that these surfaces are dry and free of contamination before moving on to the next step.

Ensure the pressure seals are seated properly after this operation.

**14.** Install Rear Cover.

Mount the cover on the body. Ensure the arrow on the back is oriented properly. The arrow should be In the same direction as the flow.

Ensure that all the pressure seals stay in place during this operation.



**15.** Prepare pump for front flange assembly.

Place the pump with the rear cover downwards.

Ensure that the assembly marks on the bearing block / body are properly aligned.

**16.** Install the front flange.

Install a protective sleeve over the shaft. The sleeve is used to protect the shaft seal from damage by the shaft splines / keyway during front flange assembly.

Install the flange onto the body, then remove the protective sleeve.

Ensure that the seals remain seated in their grooves during this operation.

**17.** Torque sequence.

When assembling units with 01 flange and short coupled tandems, wash the capscrews and apply Medium Strength Threadlocking Compound or equivalent thread lock compound to the threads before assembly.

Install capscrews. While observing the torque sequence shown, pre tighten the capscrews. Then, using a torque wrench, tighten them to the proper torque.

Torque 44-54 Nm (32-40 ft.lbs.).

**18.** Install socket head capscrews. (03 flange and first stage of multiple).

Using a 4 mm internal hex wrench, install the socket head capscrews to the front flange and rear cover.

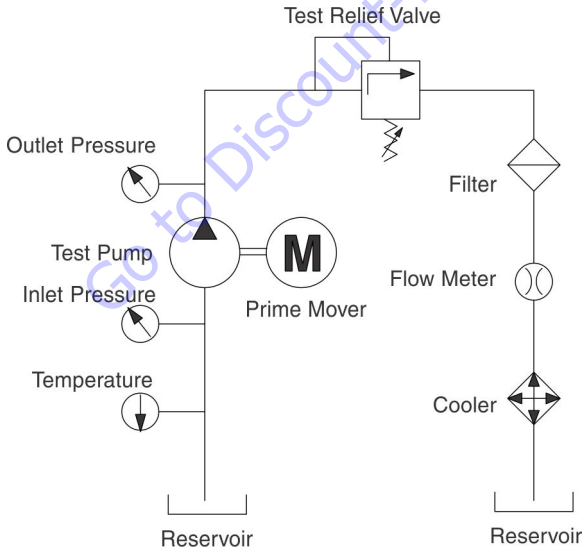
Torque 2.5-3.4 Nm (22-30 ft.lbs.).

If used, install new o-ring to flange pilot.


**19.** Testing

After pump has been disassembled and reassembled, it is suggested that the pump be run in and tested on an appropriate test stand. This is done to verify the volumetric efficiency and the integrity of the unit.

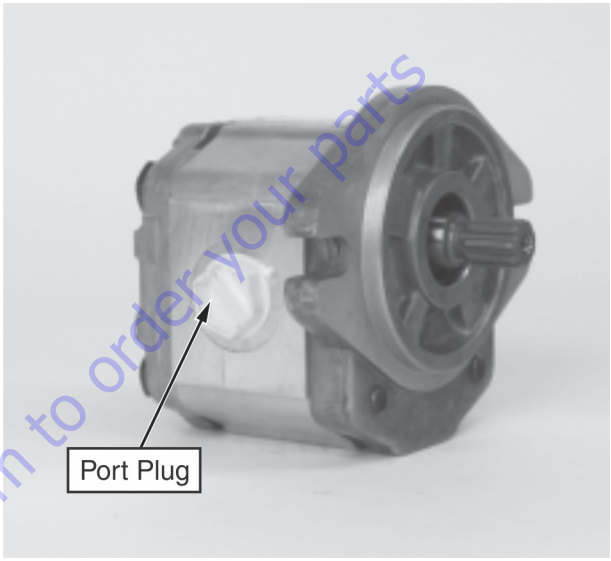
Test specifications and procedure are given in Testing the Pump.




**20.** Prepare the unit for shipment or storage.

Clean the exterior of the pump and install the following:

- **a.** Port Plugs
- **b.** Key (CI and CO shafts)
- **c.** Shaft protective cap (CI and CO shafts)
- **d.** Nut and washer (CO shaft)



## Trouble Shooting

**Table 5-43. Troubleshooting**

| **Low or No Flow From Gear Pump** | | |
|---|---|---|
| Item | Description | Action |
| 1. Check oil level in reservoir. | Description Insufficient oil to supply gear pump. | Fill reservoir to proper level. |
| 2. Check input spline condition. | Input shaft broken or stripped. | Repair or replace gear pump. |
| 3. Check pressure at pump inlet. Recommended inlet pressure: 0.8 to 3.0 bar absolute. 0.6 Minimum at cold start. | Clogged suction filter or inlet screen. | Replace filter or clean suction screen. |
| 4. Check condition of gear faces and bearing blocks. | Scored bearing block and gear faces will reduce pump efficiency. | Repair or replace gear pump. |
| 5. Check bushings. | Overpressure of gear pump will cause idler gear bushing to fail. | Repair or replace gear pump. |
| **Excessive Noise** | | |
| Item | Description | Action |
| 1. Check oil level in reservoir. | Excessive air will cause cavitation sound. | Fill reservoir to proper level . |
| 2. Check inlet line for leaks. | Excessive air will cause cavitation sound. | Repair inlet line. |
| 3. Check pressure at pump inlet. Recommended inlet pressure: 0.8 to 3.0 bar absolute. 0.6 Minimum at cold start. | Lower than normal inlet pressure causes excessive pump noise. | Return inlet pressure to recommended levels. |
| **External Leakage** | | |
| Item | Description | Action |
| 1. Check for pinched o-rings or backup ring seal. | Pinched seal will allow leakage. | Replace pinched seal. |
| 2. Check pressure seals. | Damage to pressure seals is typically caused by reduced stack-up in the pump assembly. This may be due to under-torqued assembly fasteners, or more commonly is attributed to excessive wear on the bearing blocks. Reduced stack-up will affect seal efficiency possibly to the point of seal extrusion. | Inspect condition of bearing blocks. If they are found to be worn, repair or replace the pump.<br>If bearing blocks are not worn, replace pressure seals and re-torque pump assembly fasteners. |

## 5.9 DRIVE & FUNCTION PUMP START UP PROCEDURES

### Start-Up Procedure

The Boom Lift utilizes a Triple Combination Pump coupled to the Deutz diesel engine. The pumps are connected in-line to each other as follows:

1. The front hydrostatic transmission pump, or drive pump, is coupled directly to the diesel engine and provides oil flow to operate the machine's right side wheels.
2. The middle hydrostatic transmission pump, or drive pump, is coupled to the back of the front pump and provides oil flow to operate the machine's left side wheels.
3. The third or rear pump is the function pump. It is coupled to the back of the middle pump and provides oil flow to operate the boom, axle, steer and platform functions.

The transmission pumps share some common connections. Each pumps charge oil suction ports are connected by steel tubing, the charge pumps discharge oil flows are connected and flow to a common charge pump inline oil filter, cleaned & filtered oil flows back to the transmission pumps "G" ports. The pumps case drain ports are connected (T1 & T2), oil flow from the middle pumps T1 port also provides flows to the oil cooler. The charge pumps oil pressure is regulated by a single boost oil pressure relief valve installed in the middle pump. The front pump has an orifice cartridge (0.047" diameter) installed in place of a charge oil pressure relief cartridge. This insures that only one valve controls charge pressure & provides an amount of charge oil flow to the front pump's case to insure flushing & removal of hot oil.

Each pump has its own separate electrical proportional directional control valve to control oil flow and direction. The signals or command values to each pump are similar except when steering. During steering and propel of the machine the pump supplying oil to the "inside turning radius" has a command less than the pump supplying oil flow to the "outside turning radius" pump.

"Posi-Traction" control, front to rear on a given side of the machine, is accomplished by a flow divider/combiner cartridge installed in the Traction Control Manifold. There is a flow divider/combiner for each side. Each flow divider/combiner also has a "bleed orifice" to limit the amount of flow splitting or combining.

The middle transmission pump also supplies oil to a hot oil flushing valve cartridge, #120, in the Traction Control Manifold. This cartridge provides a means to obtain brake release oil pressure. The brake release pressure is controlled by a pressure relief valve cartridge # 130 and a solenoid operated brake release directional control cartridge, #170, also located in the Traction Control Manifold. This is important to note as the brake release oil pressure must be set 25 psi (1.7 bar) below the boost oil pressure relief valve. If the brake release pressure is set too low, brake drag and pump control will be affected. If set too high, damage to the wheel drive parking brakes could result. Prior to start, connect appropriate pressure gauges to the unit.

**FOR THE START-UP OF NEW OR OVERHAULED INSTALLATIONS:**

1. Insure all electrical checks have been performed & the machine is set up correctly with the JLG Analyzer.
2. Insure the machine has all four wheels jacked & blocked off the ground per JLG procedures.
3. Insure the triple pump assembly is installed and connected correctly per the hydraulic circuit diagram.
4. Disconnect the electrical connector from the diesel's throttle actuator, to prevent engine start.
5. Crank the engine until charge pressure reaches 50 psi or more.
6. Re-connect throttle actuator electrical connector and start engine. Allow engine to run at idle speed only for at least 5 minutes. This will allow the hydrostatic system to filled.
7. Listen for any abnormal noises.
8. Check for oil leaks.
9. Check charge pressure (500 psi +50psi, - 0 psi [34.4 bar +3.4 bar, - 0 bar]). Pressure can be measured a pump ports Ma & Mb or by "teeing" into the inlet for the charge oil filter. Charge pressure is checked with the joystick in neutral. A 0-1000 psi (0-70 bar) pressure gauge must be used. (If pressure gauges were installed in Ma & Mb to check charge pressure, disconnect the gauges installed in Ma & Mb, as they will be damaged if loop pressure rises above 1000 psi [34.4 bar].)

10. Operate the drive system in the "turtle mode", forward and reverse.
11. De-aerate the system by bleeding fluid from the Ma & Mb ports.
12. Switch the drive mode speed control from "turtle" to "rabbit". Gradually increase drive speed forward & reverse, still with no load - wheels off the ground.
13. With the joystick in neutral, check for creep in neutral. If evident, most likely dirt is present in the proportional pump control, an incorrect electrical signal is present on the pump's electrical control(s) or the control was not centered properly when overhauled. See service manual for centering instructions.
14. Check that the controls are connected so that the transmissions operate in the correct direction related to control input.
15. Continue to monitor all pressure gauges & correct any irregularities.
16. Remove the brake coil (leaving the electrical connection intact) from the brake release solenoid cartridge located on the Traction Manifold. This disables the machine's ability to release the brakes! Stroke the transmission pumps slightly (less than 20%) and check the setting of the high pressure cross port relief valves. Setting should be 5000 psi +50 psi, - 0 psi (344.7 bar +3.4 bar, -0 bar). Install 0-6000 psi (0 - 415 bar) gauges on Pump ports Ma & Mb.
17. Check oil level & temperature.
18. Remove and inspect charge pressure oil filter, replace with new element.
19. Operate the transmission under no load conditions for about 15 minutes to stabilize the temperature and remove any residual air from the fluid.
20. Set the machine back on the ground. Operate the transmissions under full and normal conditions.
21. Erratic operation may indicate there is still air trapped in the system. By working the pump controls forward and reverse the remaining air can be eliminated. The system is free of air when all functions can be operated smoothly and when the oil in the reservoir is no longer aerated. (Usually less than one hour of operation)

***NOTE:*** *If the transmissions do not perform correctly after following the pre-start & start-up procedures, refer to the relevant sections of the trouble-shooting procedures.*

## 5.10 HYDRAULIC SCHEMATIC

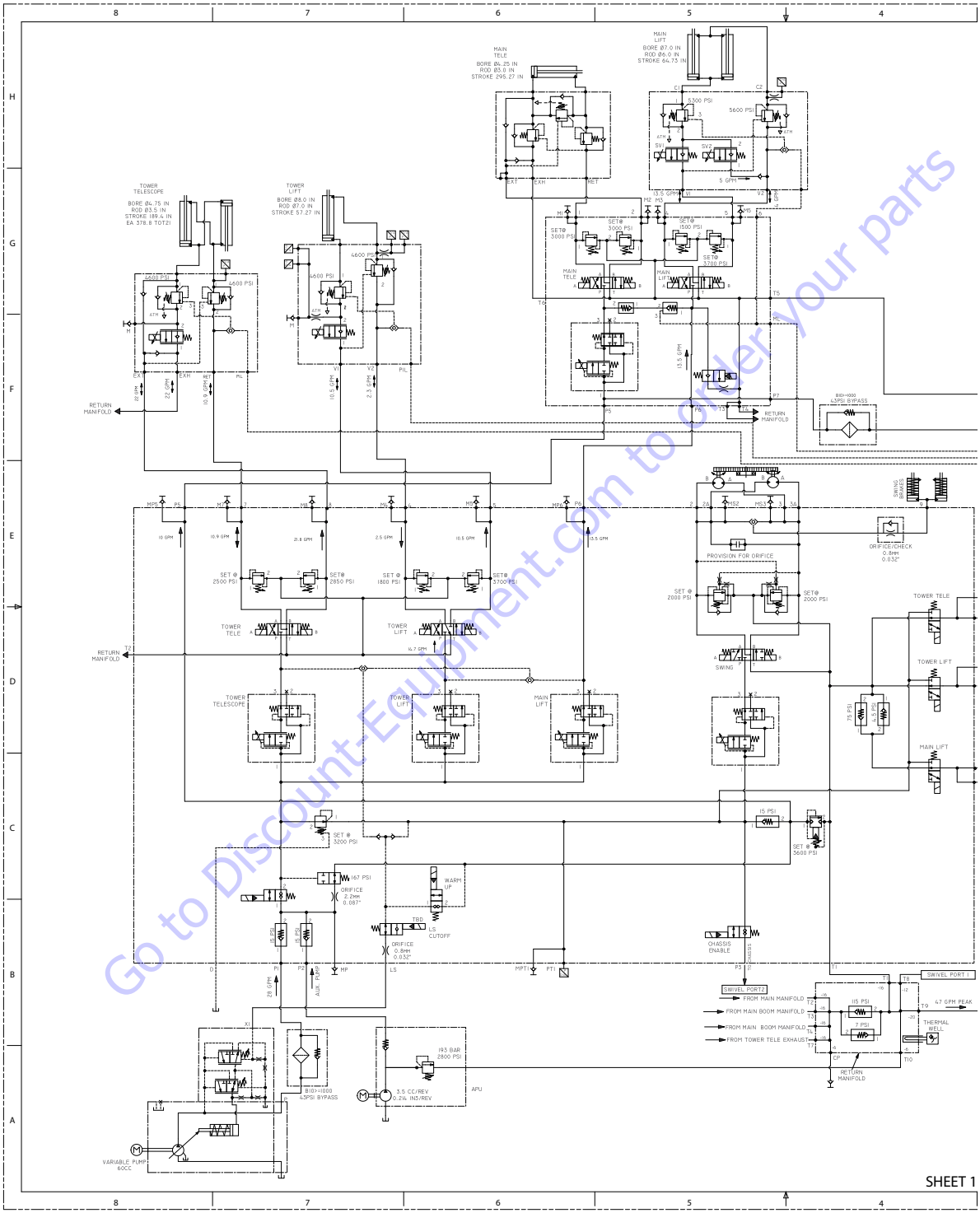





**Figure 5-141. Hydraulic Schematic - Sheet 1 of 6**

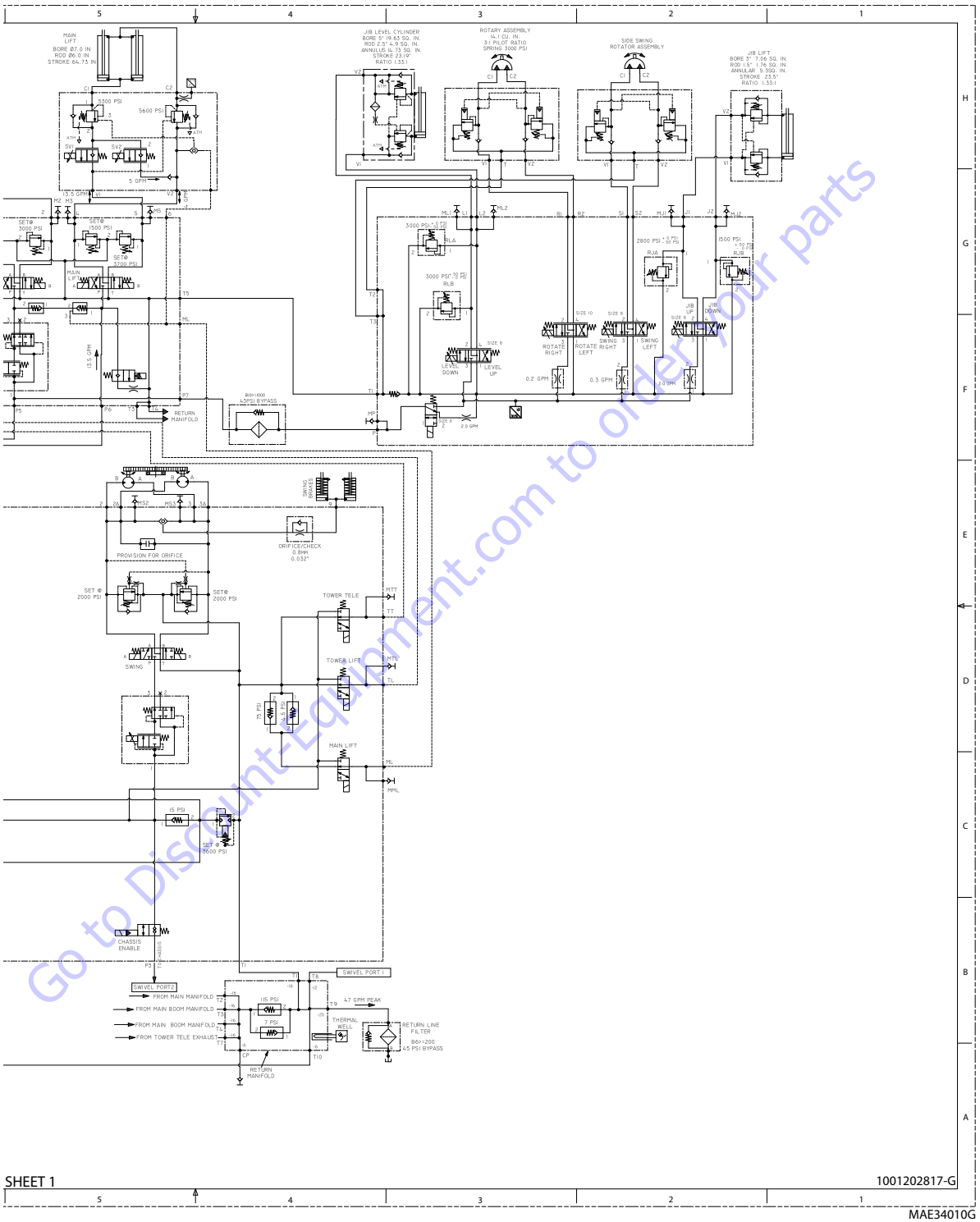





**Figure 5-142. Hydraulic Schematic - Sheet 2 of 6**

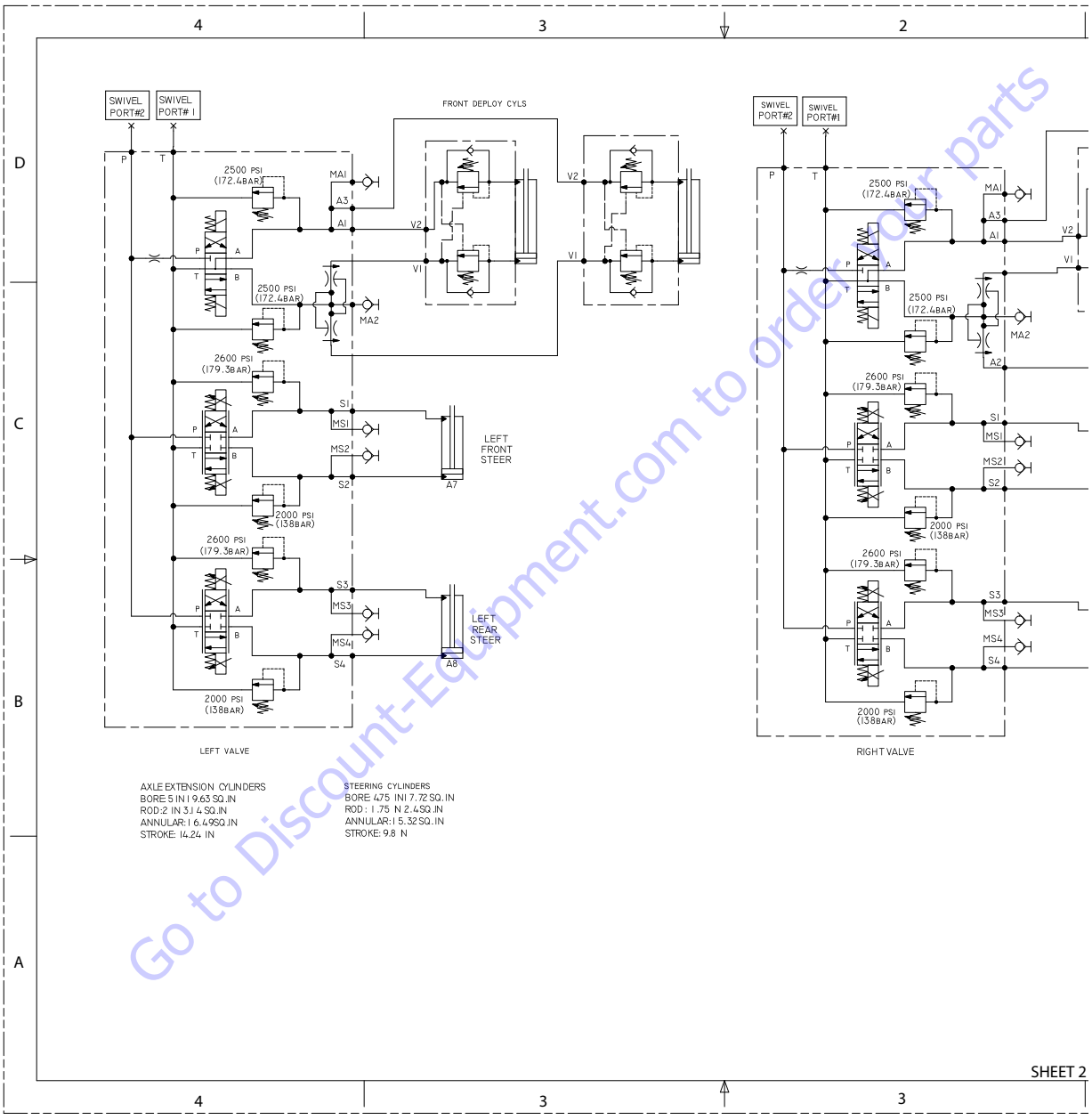





**Figure 5-143. Hydraulic Schematic - Sheet 3 of 6**

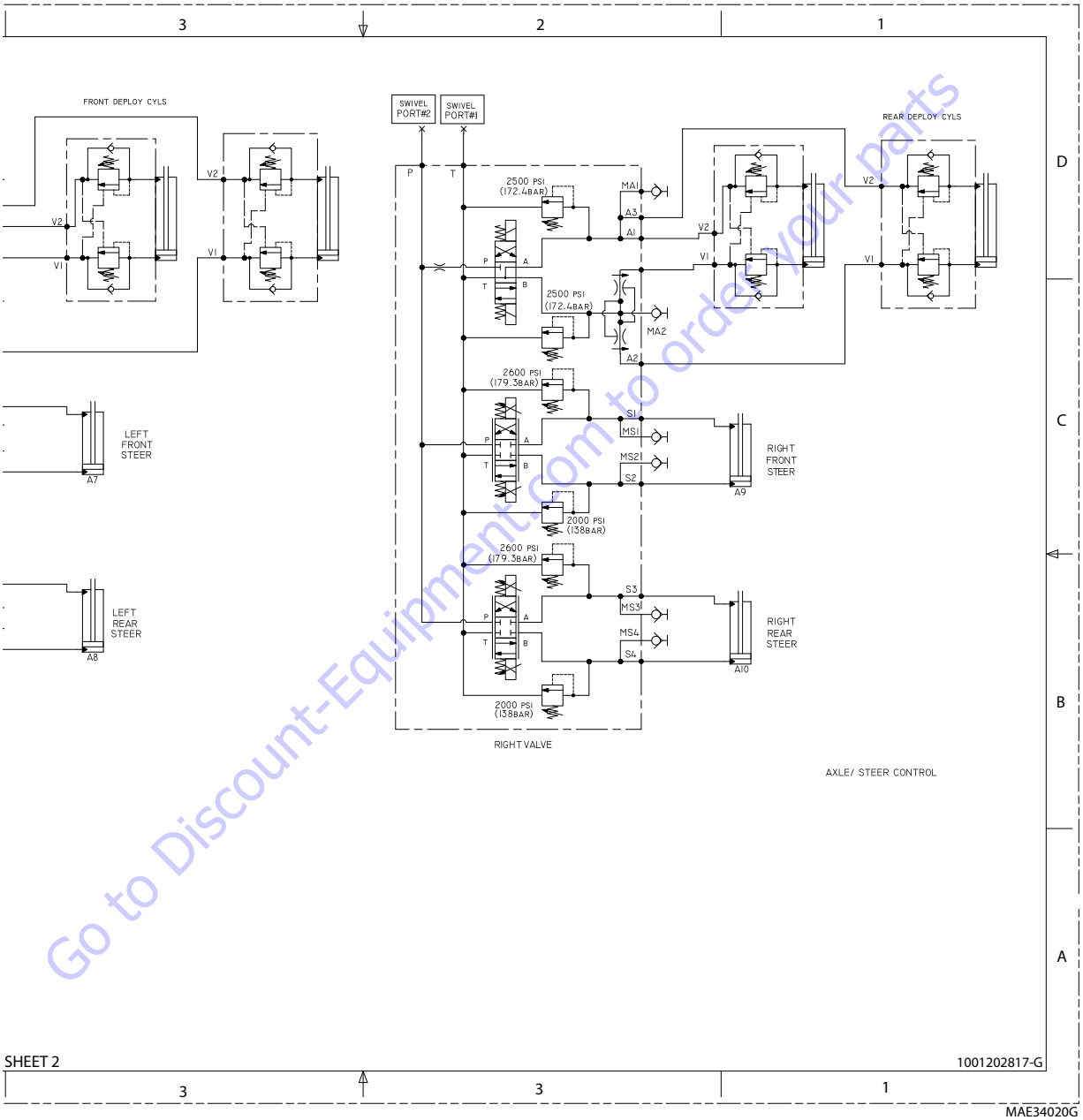





**Figure 5-144. Hydraulic Schematic - Sheet 4 of 6**

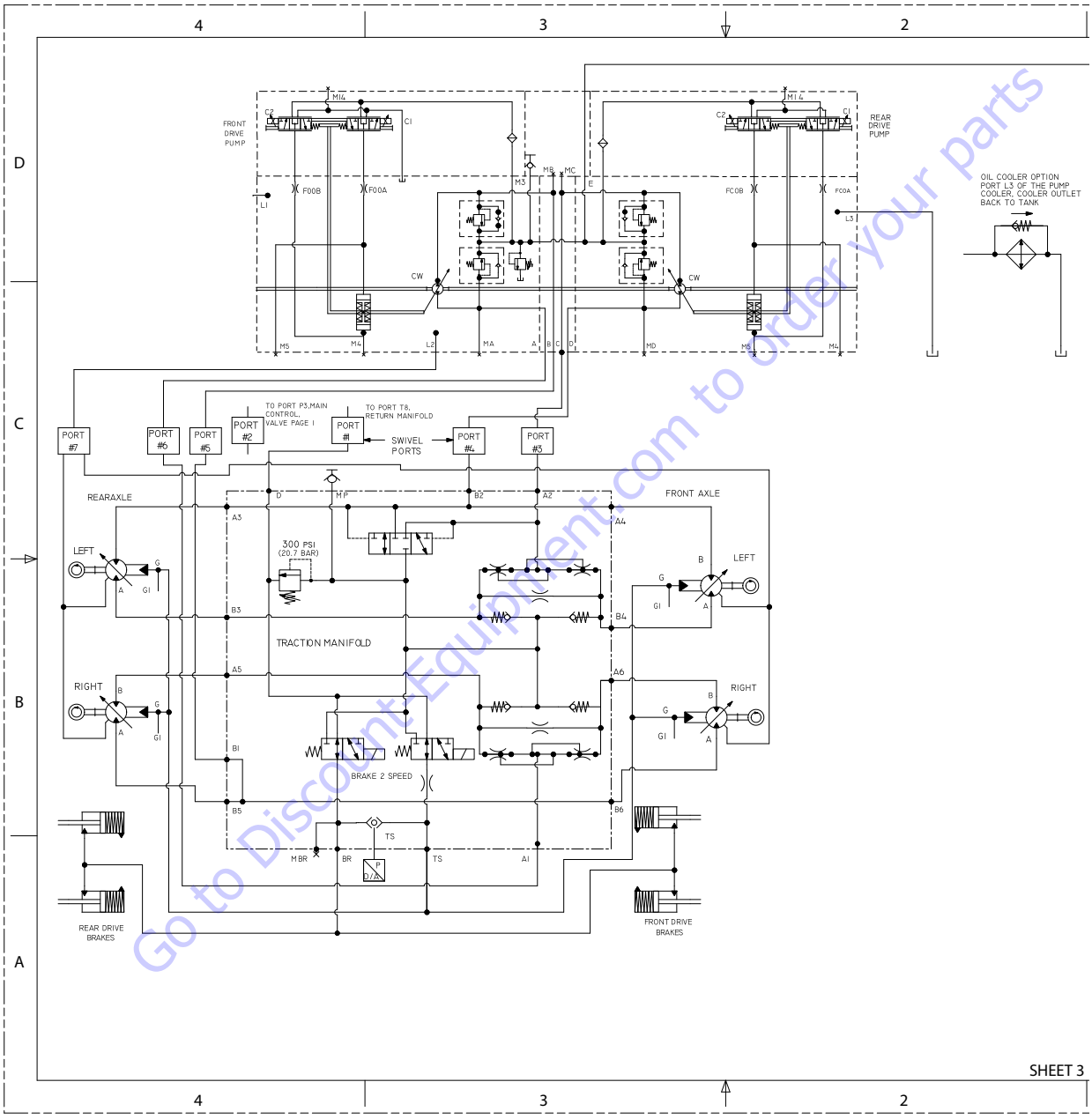





**Figure 5-145. Hydraulic Schematic - Sheet 5 of 6**

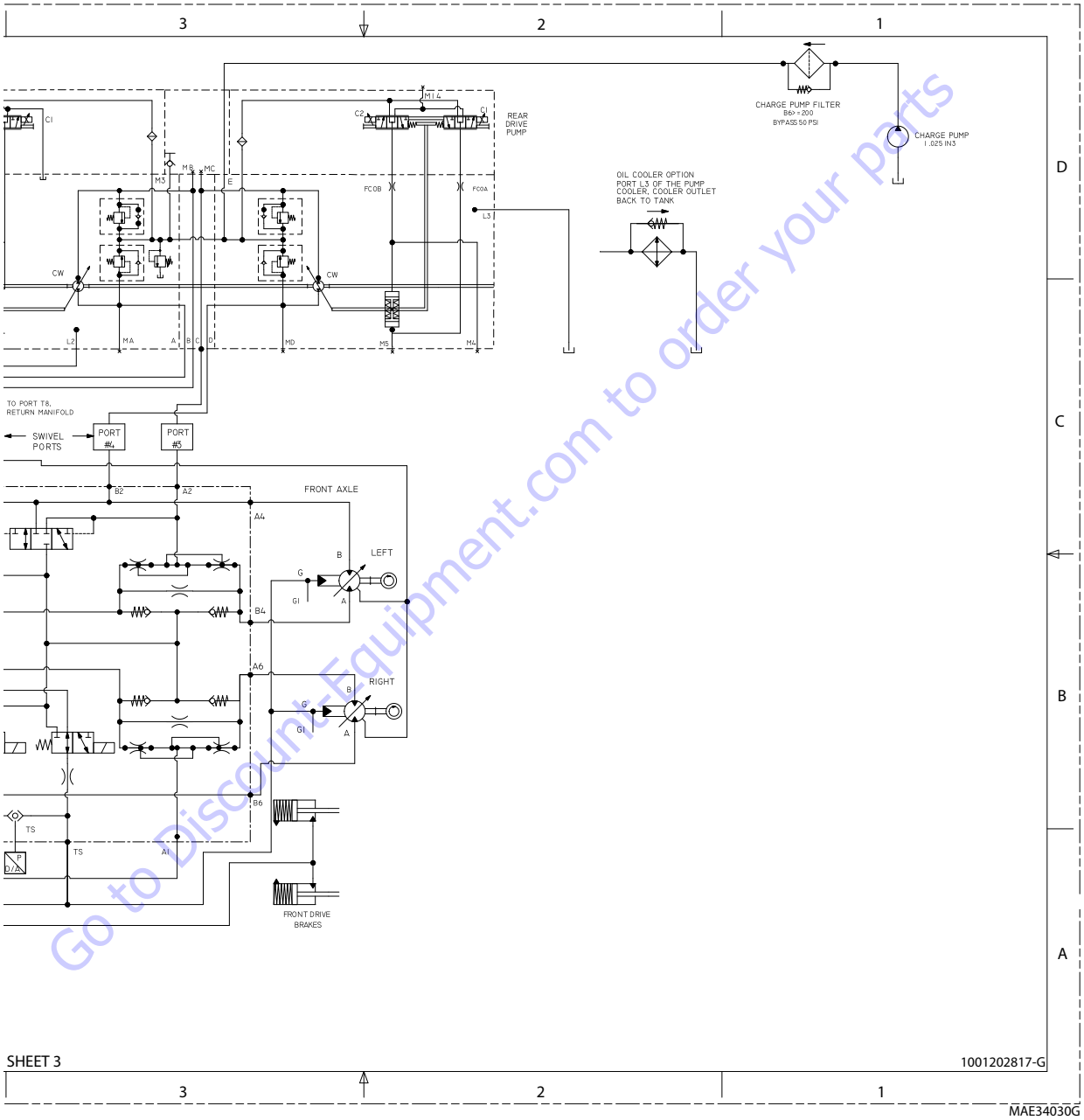





**Figure 5-146. Hydraulic Schematic - Sheet 6 of 6**

# PARTS FINDER

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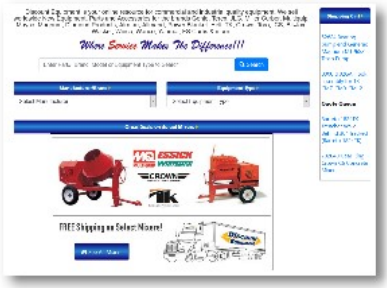
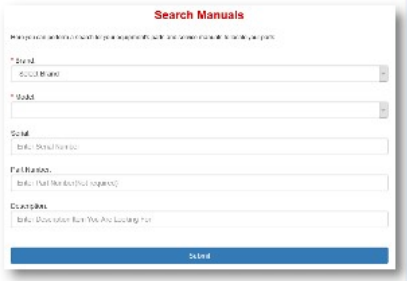
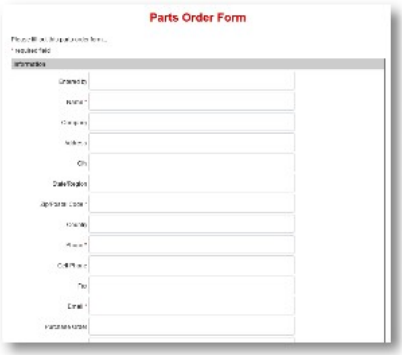


**Search Manual Library For Parts Manual & Lookup Part Numbers – Purchase or Request Quote**




**Can't Find Part or Manual? Request Help by Manufacturer, Model & Description**

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We sell worldwide for the brands: Genie, Terex, JLG, MultiQuip, Mikasa, Essick, Whiteman, Mayco, Toro Stone, Diamond Products, Generac Magnum, Airman, Haulotte, Barreto, Power Blanket, Nifty Lift, Atlas Copco, Chicago Pneumatic, Allmand, Miller Curber, Skyjack, Lull, Skytrak, Tsurumi, Husquvarna Target, , Stow, Wacker, Sakai, Mi-T- M, Sullair, Basic, Dynapac, MBW, Weber, Bartell, Bennar Newman, Haulotte, Ditch Runner, Menegotti, Morrison, Contec, Buddy, Crown, Edco, Wyco, Bomag, Laymor, Barreto, EZ Trench, Bil-Jax, F.S. Curtis, Gehl Pavers, Heli, Honda, ICS/PowerGrit, IHI, Partner, Imer, Clipper, MMD, Koshin, Rice, CH&E, General Equipment, ,AMida, Coleman, NAC, Gradall, Square Shooter, Kent, Stanley, Tamco, Toku, Hatz, Kohler, Robin, Wisconsin, Northrock, Oztec, Toker TK, Rol-Air, Small Line, Wanco, Yanmar

# SECTION 6. JLG CONTROL SYSTEM

## 6.1 INTRODUCTION

The JLG designed Control System is a 12 volt based control unit installed on the boom lift.

The JLG Control System has reduced the need for exposed terminal strips, diodes and trimpots and provides simplicity in viewing and adjusting the various personality settings for smooth control of: acceleration, deceleration, creep, min speed, and max.-speed for all boom, drive, and steering functions.

The main lift, swing, and drive are controlled by individual joysticks, with steering being controlled by a rocker switch built into the top the drive joystick. To activate Drive, Lift, and Swing simply pull up on the slide lock location on the joystick and move the handle into the direction desired.

The control system will control the voltage output to the valves and pump, as programmed for smooth operation and maximum cycle time. Ground control speeds for all boom functions can also be programmed into the control system.

The JLG Control System controller has a built in LED to indicate any faults. The system stores recent faults which may be accessed for troubleshooting. Optional equipment includes a soft touch system, head and tail lights, and ground alarm. These options may be added later but must be programmed into the control system when installed.

## 6.2 ELECTRICAL RETRIEVAL SYSTEM

***NOTE:*** *When operating in the Electrical Retrieval Mode, operate the functions a minimum of 2 seconds to ensure the JLG Control System can calculate the moment of the boom.*

The Electrical Retrieval System provides a backup means of retrieving an elevated boom in the event of a fault related to any sensor used in the envelope control system (refer to Envelope Control System in Section 4). Although this system is continuously monitored, it is not active until a fault is detected within the envelope control system.

The electrical retrieval system uses pressure sensors located on the tower boom lift cylinder to determine the force on the cylinder. Due to the complex movements of an articulated boom, individual movements of the boom cannot be controlled based on this force. The control system uses this force reading to select one of two sequences of retrieving the boom in a manner necessary to maintain the stability and structural integrity of the machine.

The two sequences of boom retrieval are determined based on the boom being closest to a position of forward stability concern or closest to a position of backward stability concern. Regardless of the sequence selected by the control system, the control system must recognize successive positions of the main and tower booms before continuing with the sequence.

While operating in this mode, the positions of the booms are determined by sensors not used by the primary envelope control system. These include the tower length switch, tower cylinder angle sensor, main boom angle switch, main boom length switch, and tower lift pressure transducers.

Operating in this mode will result in reduced function speeds, BCS warning light illumination, and restriction of functions. The platform alarm will sound and the BCS light will flash with attempts to operate restricted functions. When operating a permitted function, the BCS light will illuminate without flashing until the fault is cleared.

## 6.3 HYDRAULIC RETRIEVAL SYSTEM

The Hydraulic Retrieval System provides a backup means of retrieving elevated booms in the event of a recognized fault within the primary hydraulic control system related to the main lift, tower lift, main telescope, and tower telescope functions. The control system monitors the primary hydraulic control system for short and open circuits, and unexpected boom sensor response to command.

When a fault is detected, the control system automatically bypasses the appropriate hydraulic components and using alternative valves and control logic allows the operator to return the boom to the ground. In some cases the boom will be allowed to move only to the extent gravity is capable of assisting and in other cases the boom will be powered to allow complete retrieval to the transport position.

Although the envelope control system remains active during the hydraulic retrieval, the tower lift functionality will follow the tower path (refer to Tower Path Control System in Section 4). Rather than the normal combined movements of tower lift, tower telescope, and main lift, the tower lift movements will move in an alternating sequence between tower lift and tower telescope with the automatic main lift system (refer to Automatic Main Boom Control System in Section 4) disabled. Operating in this mode will result in reduced function speeds, BCS warning light illumination, and restriction of functions. The platform alarm will sound and the BCS light will flash with attempts to operate restricted functions.

## 6.4 JLG CONTROL SYSTEM ANALYZER KIT INSTRUCTIONS

**NOTICE**

**WHEN INSTALLING A NEW POWER MODULE CONTROLLER ON THE MACHINE, IT WILL BE NECESSARY TO PROGRAM THE CONTROLLER FOR THE PROPER MACHINE CONFIGURATION, INCLUDING OPTIONS.**

**NOTICE**

**IT IS A GOOD PRACTICE TO AVOID PRESSURE-WASHING ELECTRICAL/ELECTRONIC COMPONENTS. SHOULD PRESSURE-WASHING BE UTILIZED TO WASH AREAS CONTAINING ELECTRICAL/ELECTRONIC COMPONENTS, JLG INDUSTRIES, INC. RECOMMENDS A MAXIMUM PRESSURE OF 750 PSI (52 BAR) AT A MINIMUM DISTANCE OF 12 INCHES (30.5 CM) AWAY FROM THESE COMPONENTS. IF ELECTRICAL/ELECTRONIC COMPONENTS ARE SPRAYED, SPRAYING MUST NOT BE DIRECT AND BE FOR BRIEF TIME PERIODS TO AVOID HEAVY SATURATION.**

The Control System may be accessed utilizing a custom designed, hand held analyzer (Analyzer Kit, JLG part no. 2901443) which will display two lines of information at a time, by scrolling through the program.

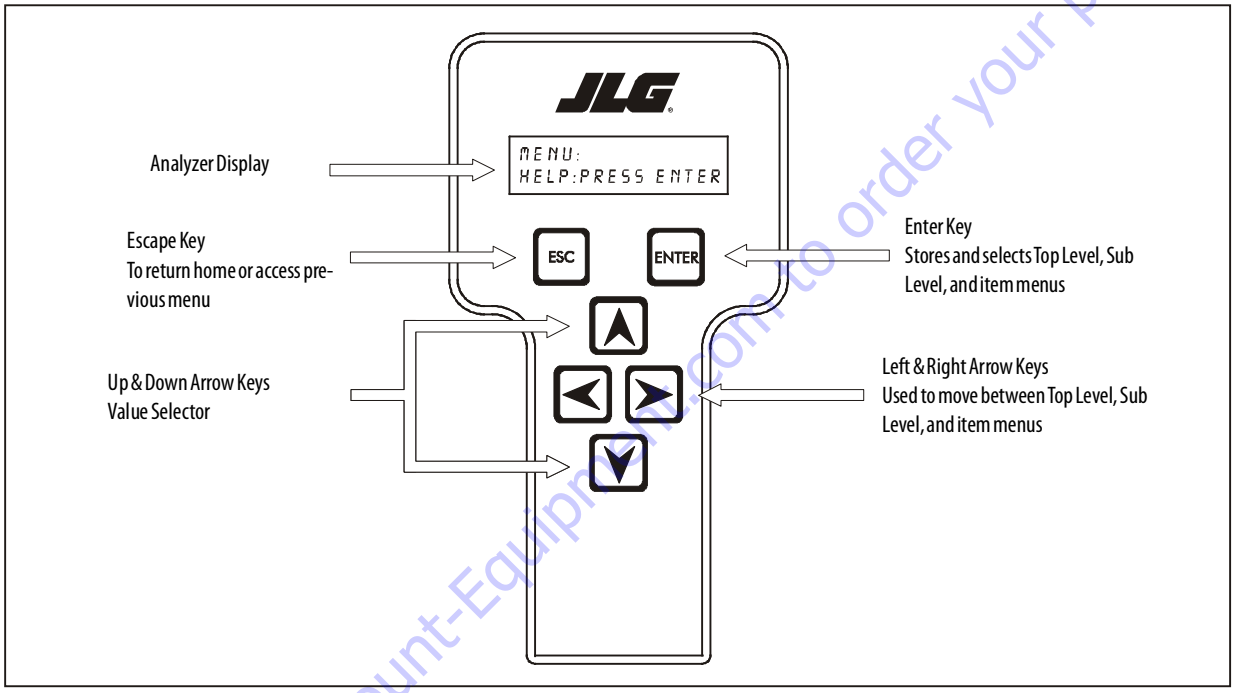



**Figure 6-1. Hand Held Analyzer**

## To Connect the JLG Control System Analyzer

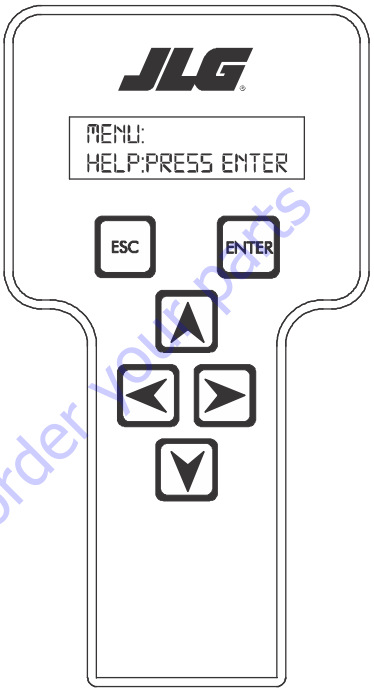
1. Connect the four pin end of the cable supplied with the analyzer, to the motor controller module located in the platform box or at the power module and connect the remaining end of the cable to the analyzer.

***NOTE:*** *The cable has a four pin connector at each end of the cable; the cable cannot be connected backwards.*

2. Power up the Control System by turning the lower key to the platform or ground position and pulling both emergency stop buttons on.

## Using the Analyzer

With the machine power on and the analyzer connected properly, the analyzer will display the following:




**HELP:**
**PRESS ENTER**

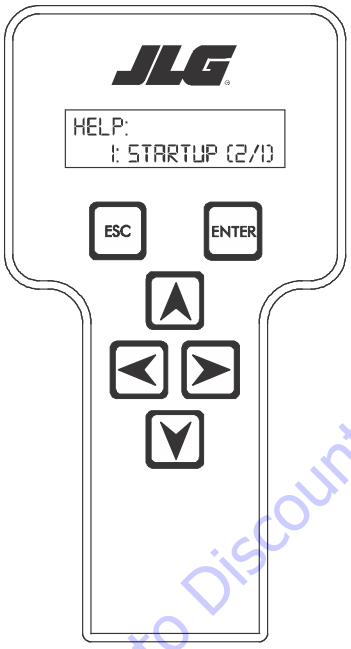
At this point, using the RIGHT  and LEFT  arrow keys, you can move between the top level menu items. To select a displayed menu item, press ENTER  . To cancel a selected menu item, press Escape  ; then you will be able to scroll using the right and left arrow keys to select a different menu item.

The top level menus are as follows:

**HELP**
**DIAGNOSTICS**
**ACTIVATE TEST**
**ACCESS LEVEL**
**PERSONALITIES**
**MACHINE SETUP**
**LEVEL VEHICLE (level 1 only)**
**CALIBRATIONS (view only)**

If you press **ENTER** (ENTER), at the **HELP: PRESS ENTER** display, and a fault is present, the analyzer display will scroll the fault across the screen. If there was no fault detected, the display will read: **HELP: EVERYTHING OK.** If powered up at the ground station, the display will read: **GROUND OK.**

If **ENTER** (ENTER) is pressed again, the display moves to the following display:




**LOGGED HELP**
**1: STARTUP (2/1)**

At this point, the analyzer will display the last fault the system has seen, if any are present. You may scroll through the fault logs to view what the last 25 faults were. Use the right and left arrow keys to scroll through the fault logs. To return to the beginning, press **ESCAPE** (ESC) two times. **STARTUP (2/1)** indicates a power up.

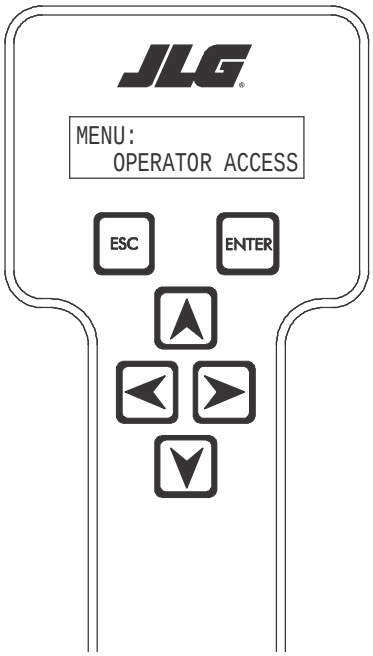
When a top level menu is selected, a new set of menu items may be offered: for example:

**DRIVE**
**BOOM**
**SYSTEM**
**DATALOG**
**VERSIONS**

Pressing **ENTER** (ENTER) with any of the above displayed menus, will display additional sub-menus within the selected menu. In some cases, such as **DRIVE**, the next level is the parameter or information to be changed. Refer to the flow chart for what menus are available within the top level menus. You may only view the personality settings for selected menus while in OPERATOR ACCESS. Remember, you may always cancel a selected menu item by pressing the **ESCAPE** (ESC) key.

## Changing the Access Level of the Hand Held Analyzer

When the analyzer is first connected, you will be in Operator Access which enables you to only view most settings which cannot be changed until you enter a password to advance to a lower level. This ensures that a setting cannot be accidentally altered. To change the access level, the correct password must be entered. To enter the password, scroll to the **ACCESS LEVEL** menu. For example:



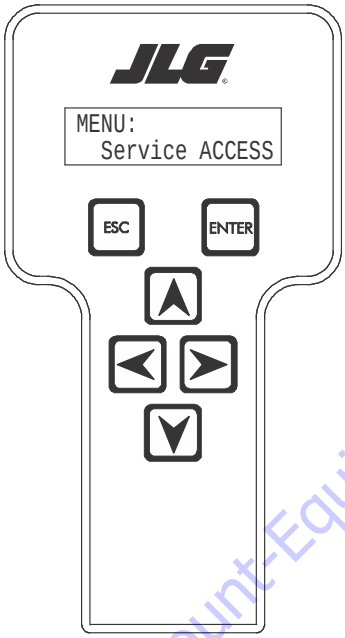

Press **ENTER** (ENTER) to select the **ACCESS LEVEL** menu.

Using the **UP** or **DOWN** arrow keys, enter the first digit of the password, 3.

Then using the **RIGHT** arrow key, position the cursor to the right one space to enter the second digit of the password.

Use the **UP** or **DOWN** arrow key to enter the second digit of the password which is 33271.

Once the correct password is displayed, press **ENTER**. The access level should display the following, if the password was entered correctly:

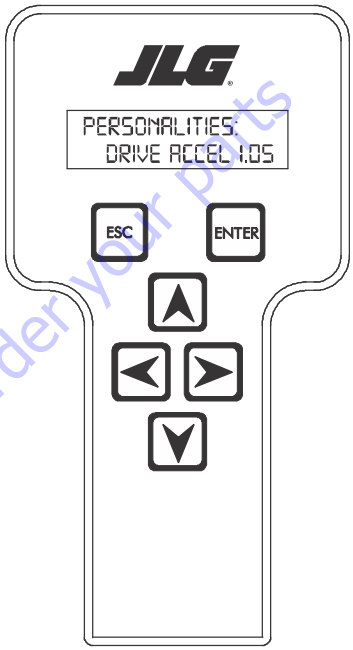



**MENU:**
**SERVICE ACCESS**

Repeat the above steps if the correct access level is not displayed or you can not adjust the personality settings.

## Adjusting Parameters Using the Hand Held Analyzer

Once you have gained access to level 1, and a personality item is selected, press the **UP** or **DOWN** arrow keys to adjust its value, for example:

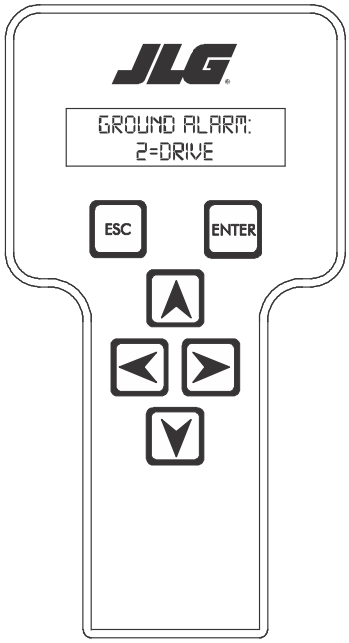



**DRIVE:**
**ACCEL 1.5s**

There will be a minimum and maximum for the value to ensure efficient operation. The Value will not increase if the **UP** arrow is pressed when at the maximum value nor will the value decrease if the **DOWN** arrow is pressed and the value is at the minimum value for any particular personality. If the value does not change when pressing the up and down arrows, check the access level to ensure you are at access level 1.

## Machine Setup

When a machine digit item is selected, press the **UP** or **DOWN** arrow keys to adjust its value, for example:




**GROUND ALARM:**
**2 = DRIVE**

The effect of the machine digit value is displayed along with its value. The above display would be selected if the machine was equipped with a ground alarm and you wanted it to sound when driving. There are certain settings allowed to install optional features or select the machine model.

When selection the machine model to match the size of the machine, the personality settings will all default to the factory recommended setting.

***NOTE:*** *Refer to Personality Ranges/Defaults for the recommended factory settings.*

***NOTE:*** *Password 33271 will give you access to level 1, which will permit you to change all machine personality settings.*

There is a setting that JLG strongly recommends that you do not change. This setting is so noted below:

**ELEVATION CUTBACK**

**⚠ WARNING**

**CHANGING THIS SETTING MAY ADVERSELY AFFECT THE PERFORMANCE OF YOUR MACHINE.**

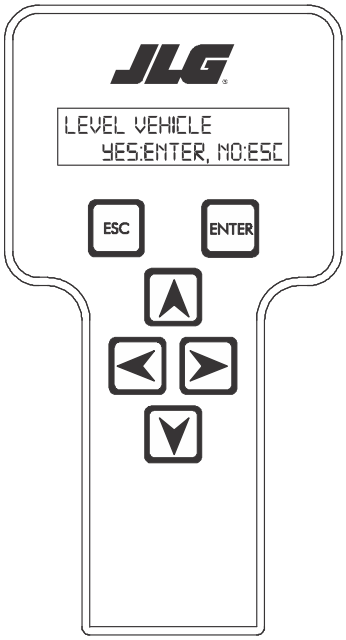
**NOTICE**

**ITS IS A GOOD PRACTICE TO AVOID PRESSURE-WASHING ELECTRICAL/ELECTRONIC COMPONENTS. SHOULD PRESSURE-WASHING BE UTILIZED TO WASH AREAS CONTAINING ELECTRICAL/ELECTRONIC COMPONENTS, JLG INDUSTRIES INC. RECOMMENDS A MAXIMUM PRESSURE OF 750 PSI (52 BAR) AT A MINIMUM DISTANCE OF 12 INCHES (30.5CM) AWAY FROM THESE COMPONENTS. IF ELECTRICAL/ELECTRONIC COMPONENTS ARE SPRAYED, SPRAYING MUST NOT BE DIRECT AND BE FOR BRIEF TIME PERIODS TO AVOID HEAVY SATURATION.**

## Level Vehicle Description

**⚠ WARNING**

**DO NOT LEVEL VEHICLE EXCEPT ON A LEVEL SURFACE.**




LEVEL VEHICLE
YES:ENTER, NO:ESC

Not available at password level 2 ENTER confirms that vehicle is currently level, and zeroes the tilt sensor measurements

## Ground Control Console Display Gauge - Machines using Diesel Exhaust Fluid (DEF)

*(See Figure 6-5., Ground Control Console Display Gauge)*

The Display Gauge shows engine hours, fuel level (if applicable), and Diagnostic Trouble Codes (DTCs) from both the JLG Control System and the engine control system. During machine start up, with no active DTCs in the control system, the splash screen will show for 3 seconds and then switch to main screen. If there is an active DTC while powering up the machine, the splash screen will show for 3 seconds, and then launch the Diagnostics Screen. The indicator lamp will light when there is an active DTC in the Fault Log.

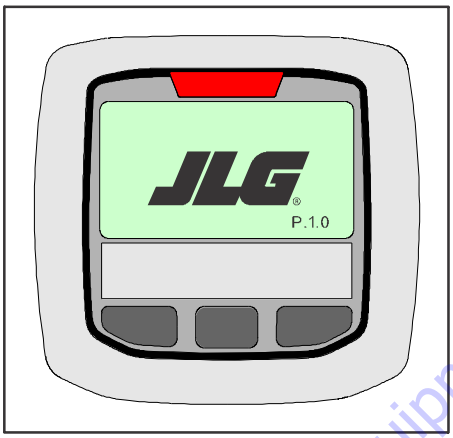



**Figure 6-2. Splash Screen**

The Diagnostic Screen will show active and inactive faults from the JLG Control System on the screen. An asterisk (*) will be displayed to show active faults.

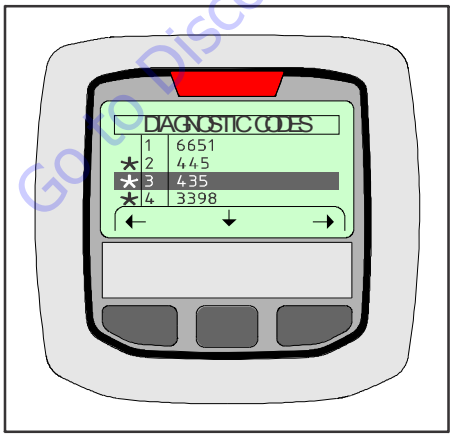



**Figure 6-3. Diagnostic Screen**

The Engine Diagnostics Screen will show SPN (Suspect Parameter Number), FMI (Failure Mode Identifier), and Occurrence count information. Engine SPN text is not scrollable. If there is more than one engine trouble code, the operator must exit from the Engine DTC Screen to see other SPN and FMI information.

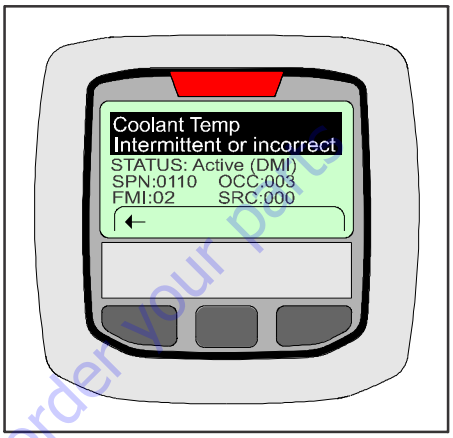



**Figure 6-4. Engine Diagnostic Screen**

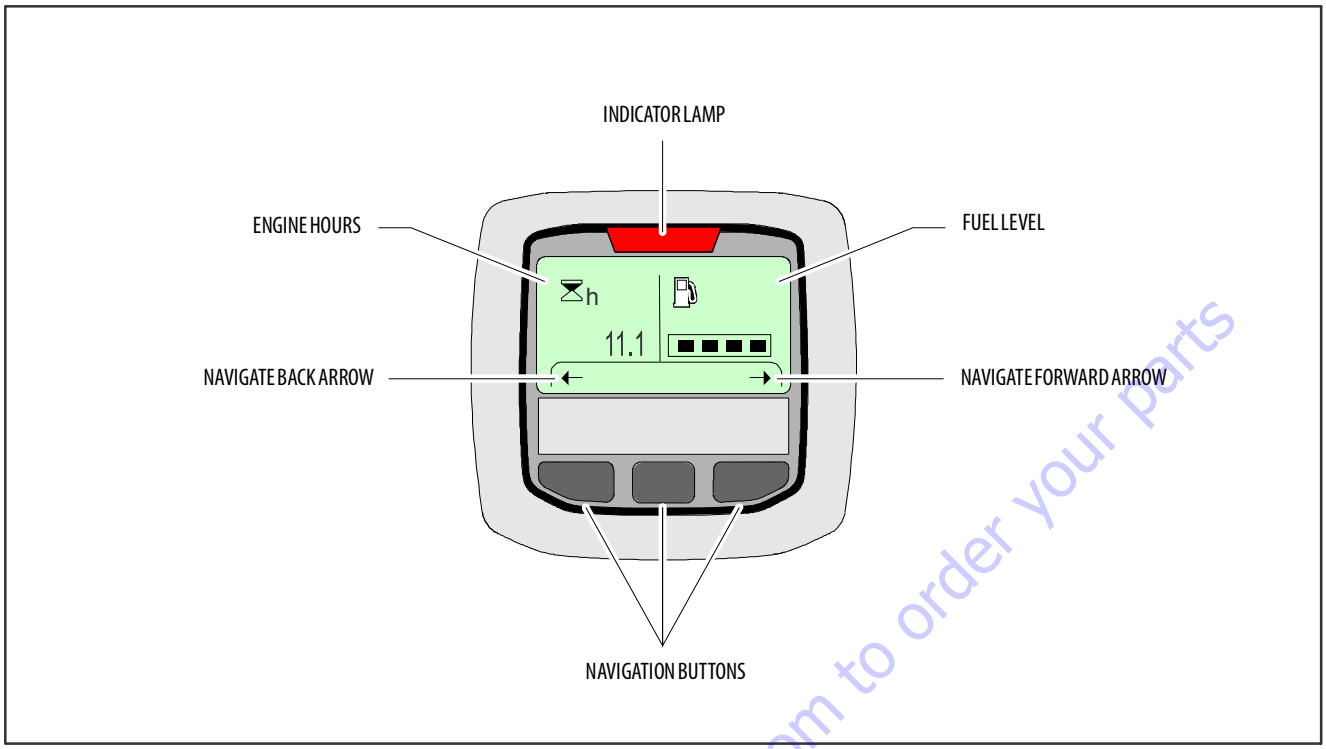



**Figure 6-5. Ground Control Console Display Gauge**

**Table 6-1. Analyzer Abbreviations**

| ABBREVIATION | MEANING |
|---|---|
| ACCEL | ACCELERATE |
| ACT | ACTIVE |
| A/D | ANALOG DIGITAL CONVERTER COUNT |
| AMB. | AMBIENT |
| ANG | ANGLE |
| AUX | AUXILIARY |
| BCS | BOOM CONTROL SYSTEM |
| BM | BOOM |
| BLAM | BOOM LENGTH ANGLE MODULE |
| BR | BROKEN |
| BRL | BARREL |
| BSK | BASKET |
| CAL | CALIBRATE or CALIBRATION |
| CHK | CHECK |
| CL | CLOSED |
| CM | CHASSIS MODULE |
| CMD | COMMAND |
| CNCT | CONNECT |
| CNT | COUNT or CONNECT |
| CNTS | COUNTS |
| CNTL | CONTROL |
| CNTRL | CONTROL |
| C/O | CUT OUT |
| CONT(S) | CONTRACTOR(S) |
| COOR | COORDINATED |
| CRK PT | CRACK POINT |
| CRP | CREEP |
| CUT | CUTOUT |
| CYL | CYLINDER |
| DECEL | DECELERATE |
| D | DOWN |
| DIR | DIRECTIONAL |
| DN | DOWN |
| DWN | DOWN |
| DEG. | DEGREE |
| DOS | DRIVE ORIENTATION SYSTEM |
| DMD | DEMAND |
| DRV | DRIVE |
| E | ERROR |
| E&T | ELEVATED & TILTED |
| ELEV | ELEVATION |
| EN | ENABLE |
| ENABLD | ENABLED |

**Table 6-1. Analyzer Abbreviations**

| ABBREVIATION | MEANING |
|---|---|
| ENG | ENGINE |
| EXT | EXTEND |
| F | FRONT |
| FCNTL | FLOW CONTROL |
| FL | FLOW |
| FNT | FRONT |
| FOR | FORWARD |
| FWD | FORWARD |
| FSW | FOOT SWITCH |
| FUNC | FUNCTION |
| G | GROUND |
| GND | GROUND |
| GRN | GREEN |
| GM | GROUND MODULE |
| H | HOURS |
| HW | HARDWARE |
| HWFS | HARDWARE FAILSAFE |
| I | IN or CURRENT |
| JOY | JOYSTICK |
| L | LEFT |
| LB | POUND |
| LEN | LENGTH |
| LFT | LIFT |
| LIM | LIMIT |
| LT | LEFT |
| LVL | LEVEL |
| M | MINUTES |
| MIN | MINIMUM |
| MAX | MAXIMUM |
| M | MAIN |
| MN | MAIN |
| MNT | MOUNT |
| NO | NORMALLY OPEN or NO |
| NC | NORMALLY CLOSED |
| O | OUT |
| O/C | OPEN CIRCUIT |
| OP | OPEN |
| O/R | OVERRIDE or OUTRIGGER |
| O//R | OVERRIDE |
| OSC | OSCILLATING |
| OVRD | OVERRIDE |
| P | PLATFORM |
| P | PRESSURE |

**Table 6-1. Analyzer Abbreviations**

| ABBREVIATION | MEANING |
|---|---|
| PCV | PROPORTIONAL CONTROL VALVE |
| PLAT | PLATFORM |
| PLT | PLATFORM |
| PLTFM | PLATFORM |
| PM | PLATFORM MODULE |
| POT | POTENTIOMETER |
| PRES | PRESSURE |
| PRS | PRESSURE |
| PRTCTR | PROTRACTOR |
| PT | POINT |
| R | REAR or RIGHT |
| REDUCTN | REDUCTION |
| REV | REVERSE or REVISION |
| RET | RETRACT |
| ROT. | ROTATE |
| RT | RIGHT |
| S/C | SHORT CIRCUIT |
| SEL | SELECTOR |
| SN | SERIAL NUMBER |
| SNSR | SENSOR |
| SPD | SPEED |
| SRV | SERVICE |
| STOW | STOWED |
| STOWD | STOWED |
| STR | STEER |
| SW | SWITCH or SOFTWARE |
| SWG | SWING |
| TELE | TELESCOPE |
| TEMP | TEMPERATURE |
| TL | TOWER LIFT |
| TORQ. | TORQUE |
| TRN | TRANSPORT |
| TT | TOWER TELESCOPE |
| T/T | TURNTABLE |
| T | TOWER |
| TURNTBL | TURNTABLE |
| TWR | TOWER |
| U | UPPER or UP |
| V | VOLT |
| VER | VERSION |
| VLV | VALVE |
| WIT | WITNESS |
| YEL | YELLOW |

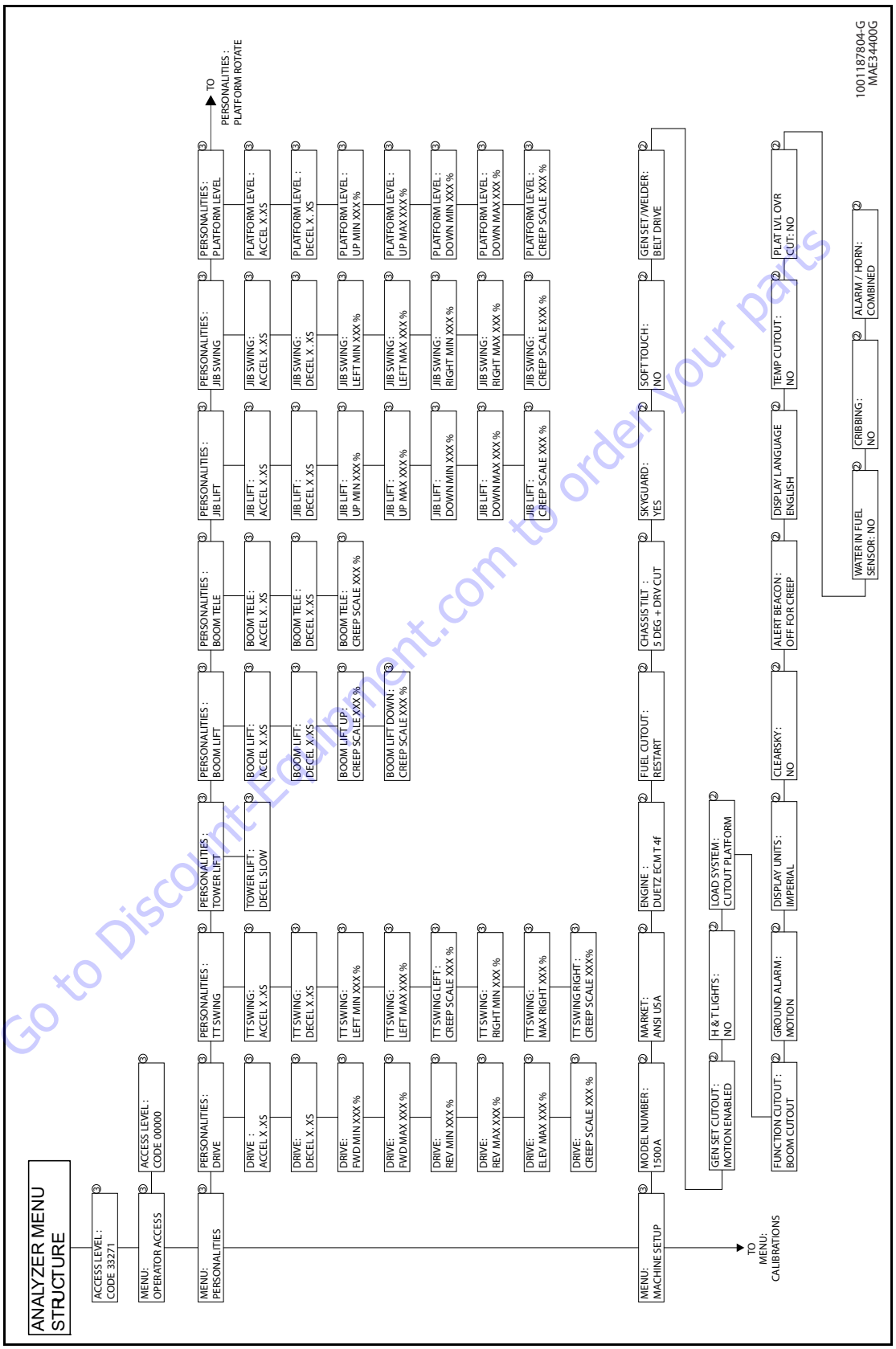





**Figure 6-6. Analyzer Flow Chart Software Version P1.6 - Sheet 1 of 10**

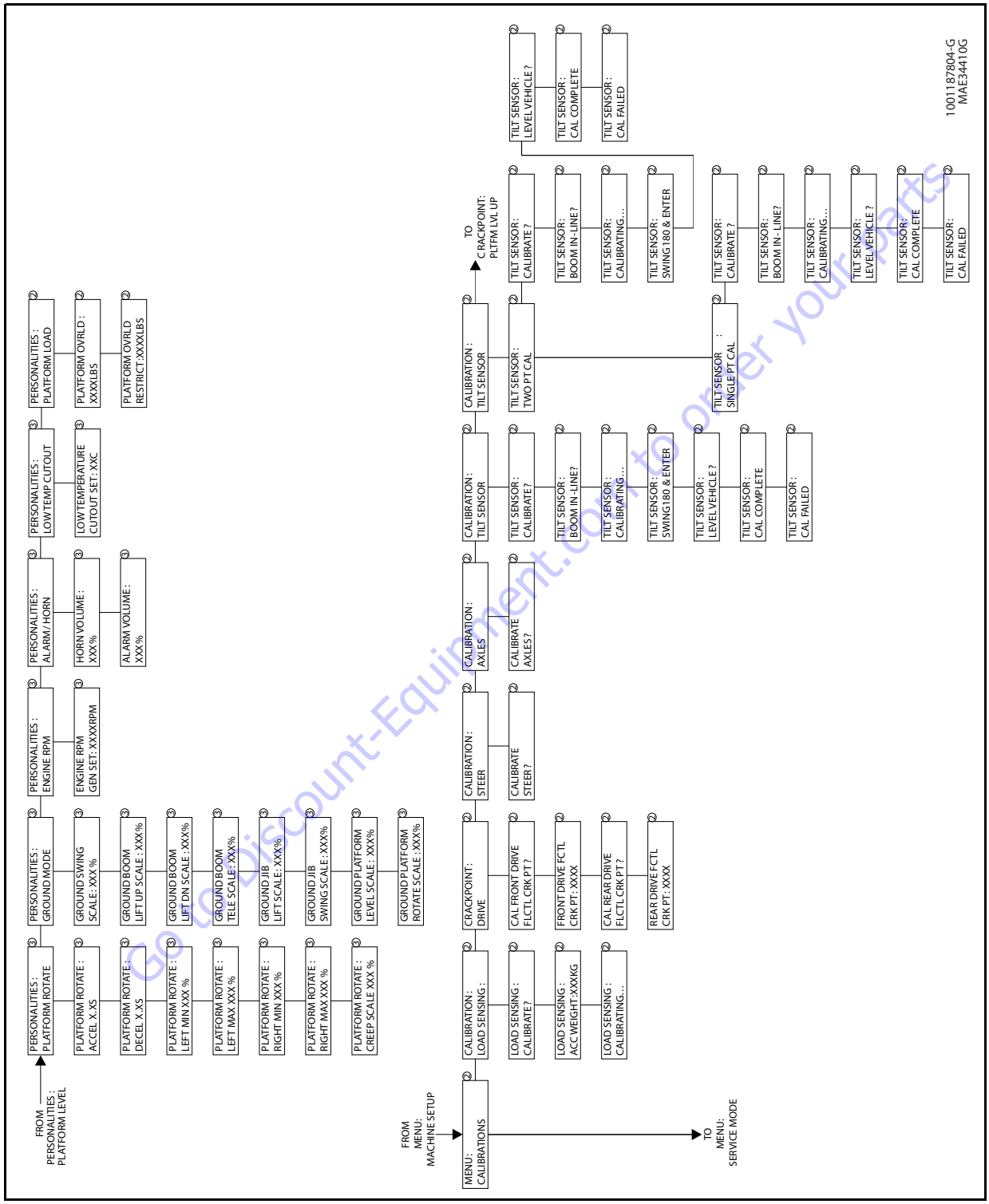



**Figure 6-7. Analyzer Flow Chart Software Version P1.6 - Sheet 2 of 10**

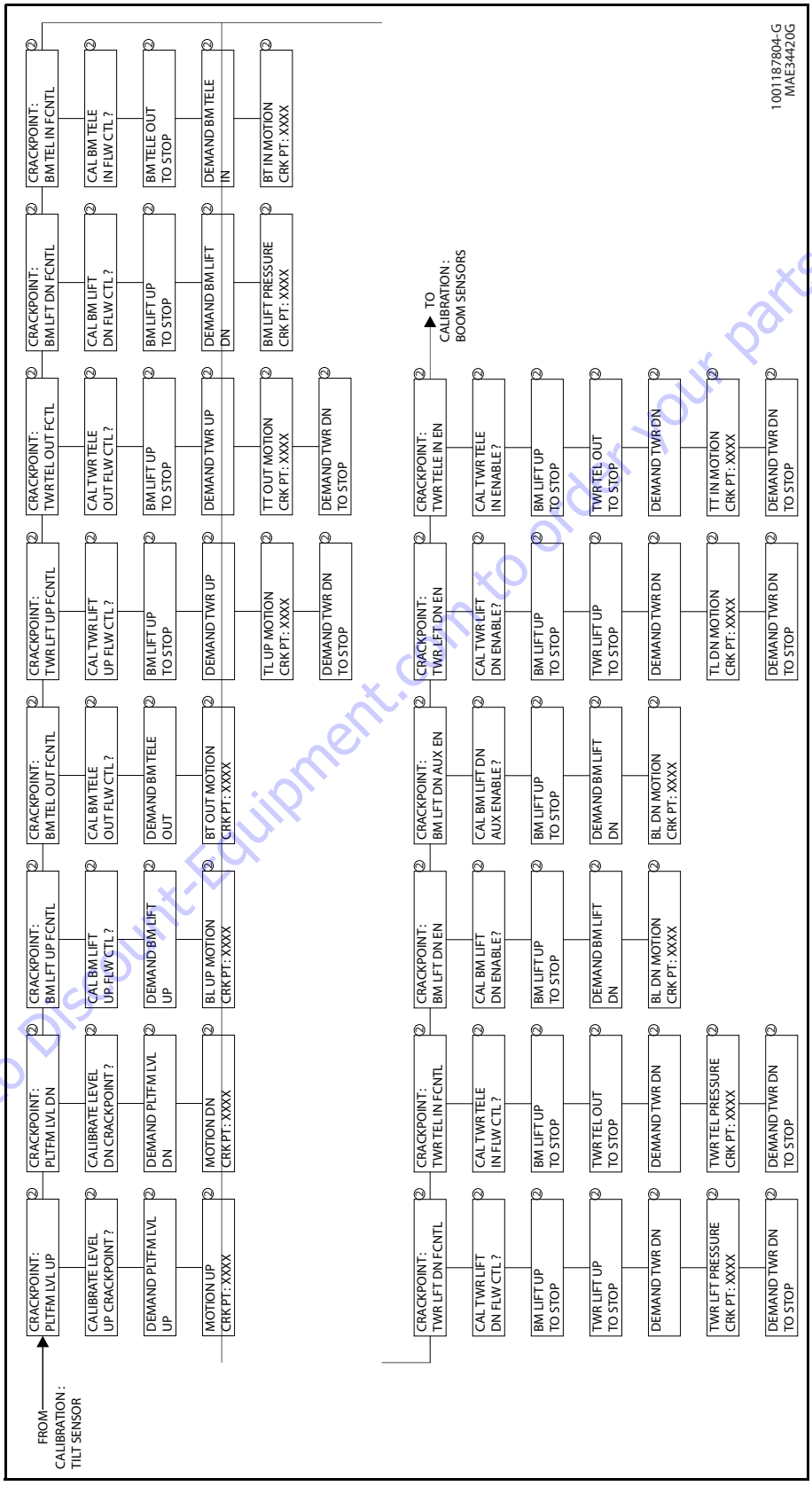





**Figure 6-8. Analyzer Flow Chart Software Version P1.6 - Sheet 3 of 10**

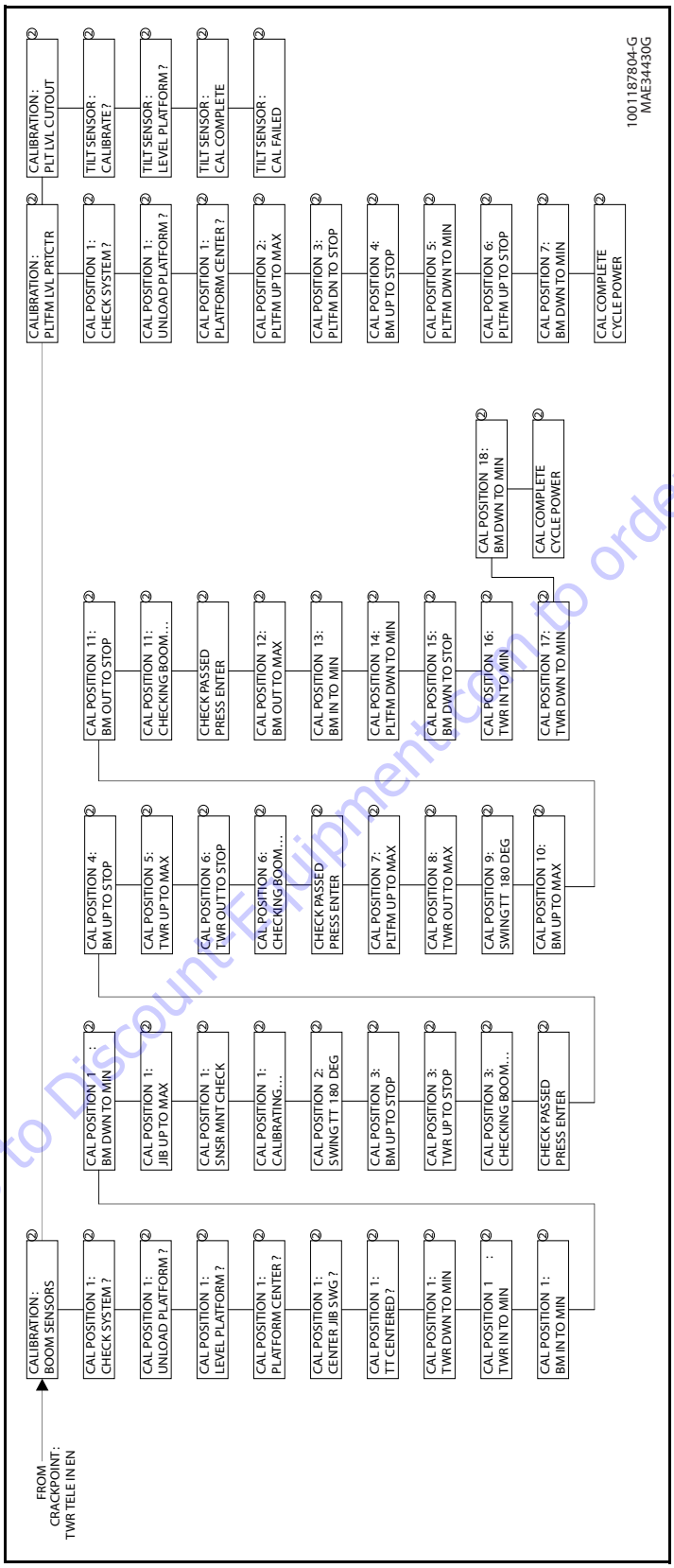



**Figure 6-9. Analyzer Flow Chart Software Version P1.6 - Sheet 4 of 10**

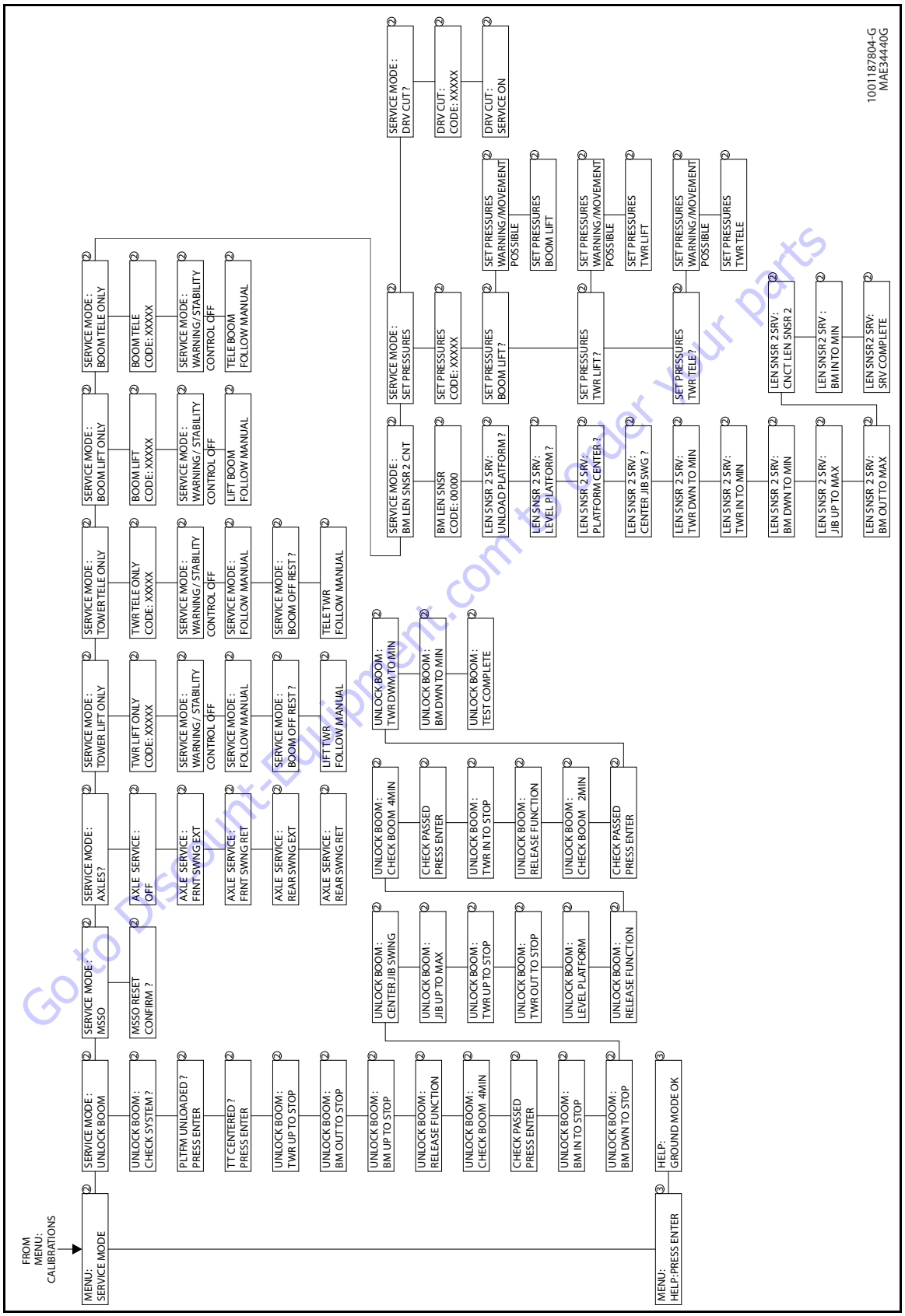



**Figure 6-10. Analyzer Flow Chart Software Version P1.6 - Sheet 5 of 10**

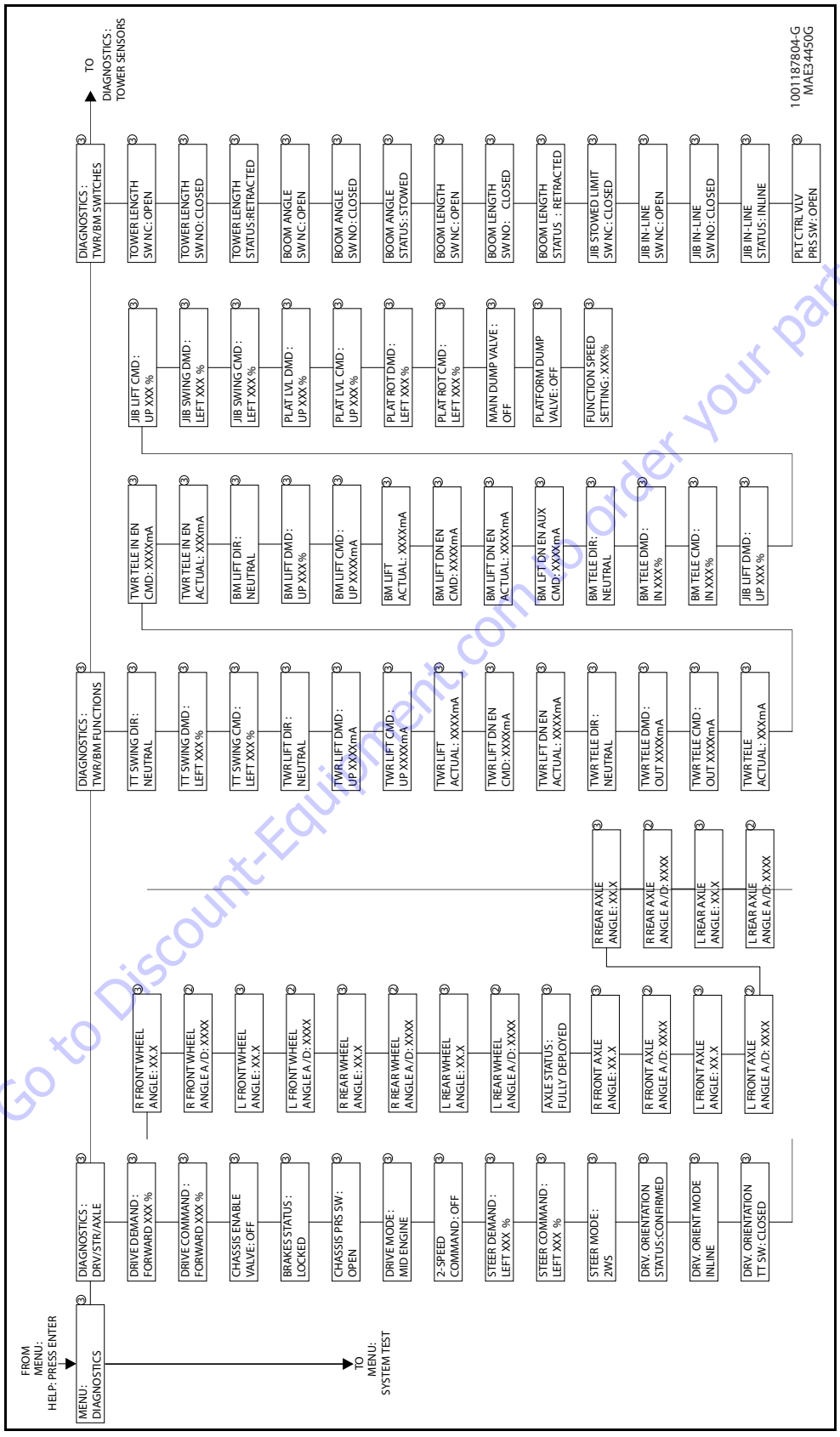



**Figure 6-11. Analyzer Flow Chart Software Version P1.6 - Sheet 6 of 10**

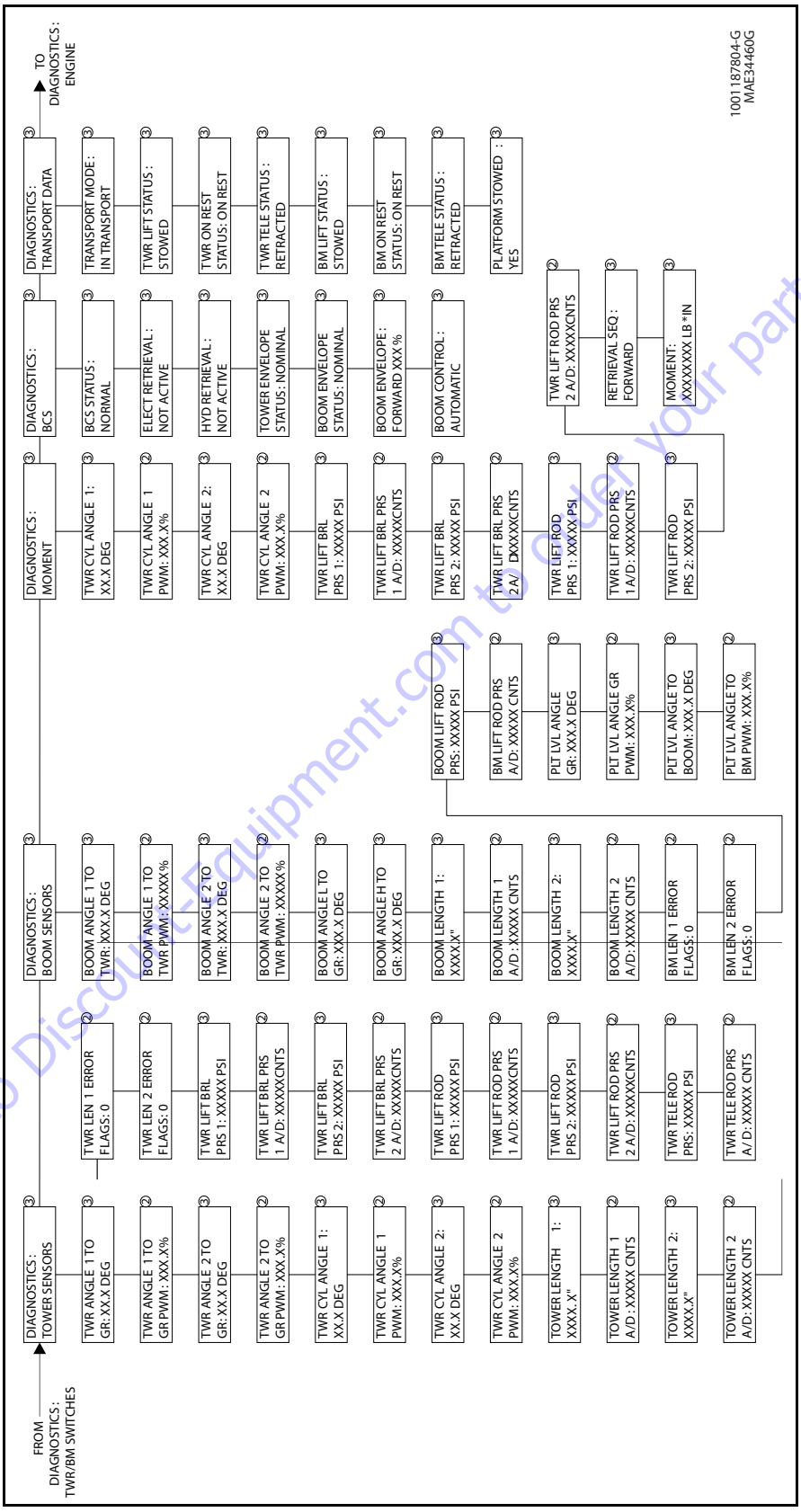



**Figure 6-12. Analyzer Flow Chart Software Version P1.6 - Sheet 7 of 10**

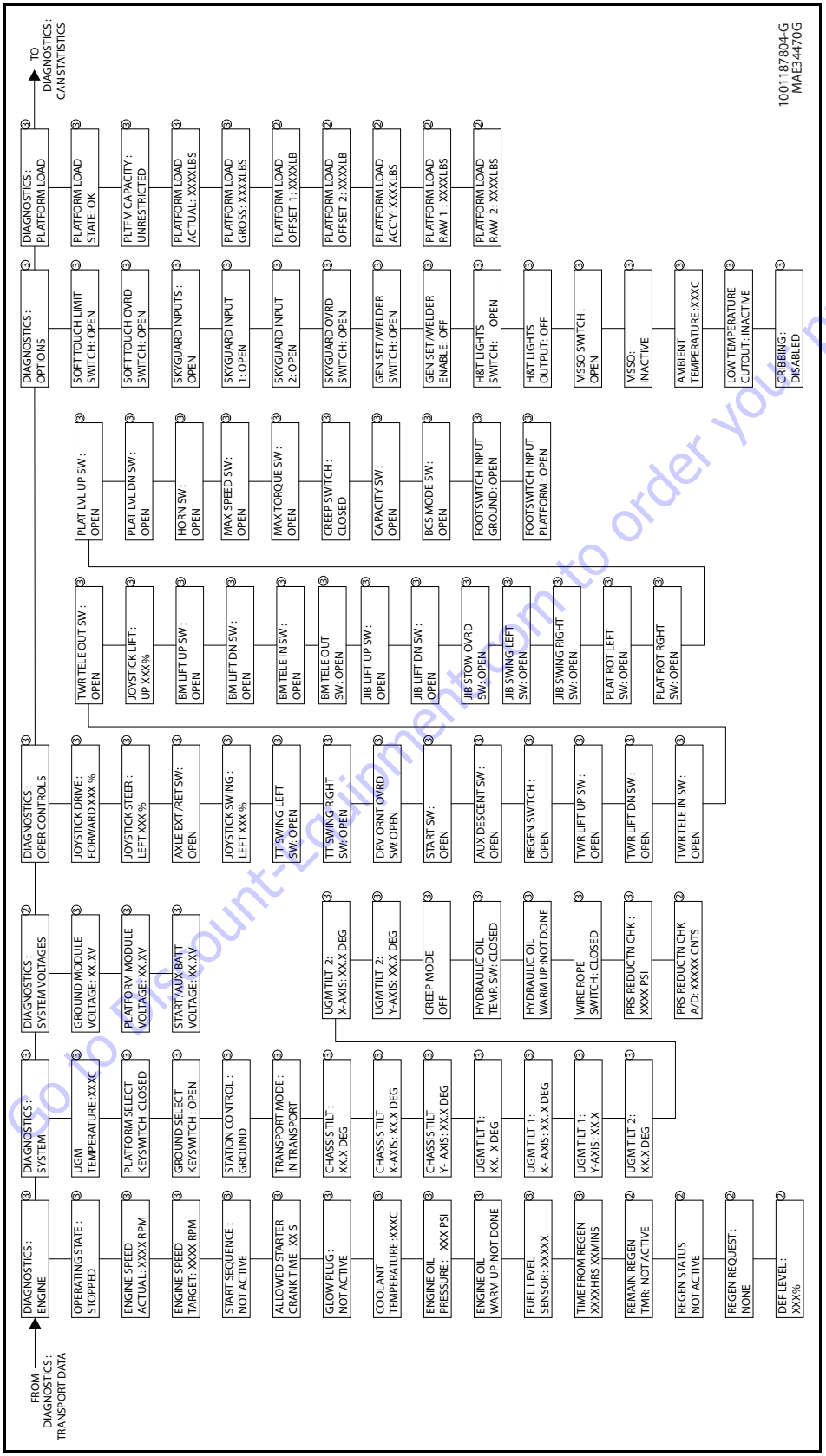





**Figure 6-13. Analyzer Flow Chart Software Version P1.6 - Sheet 8 of 10**

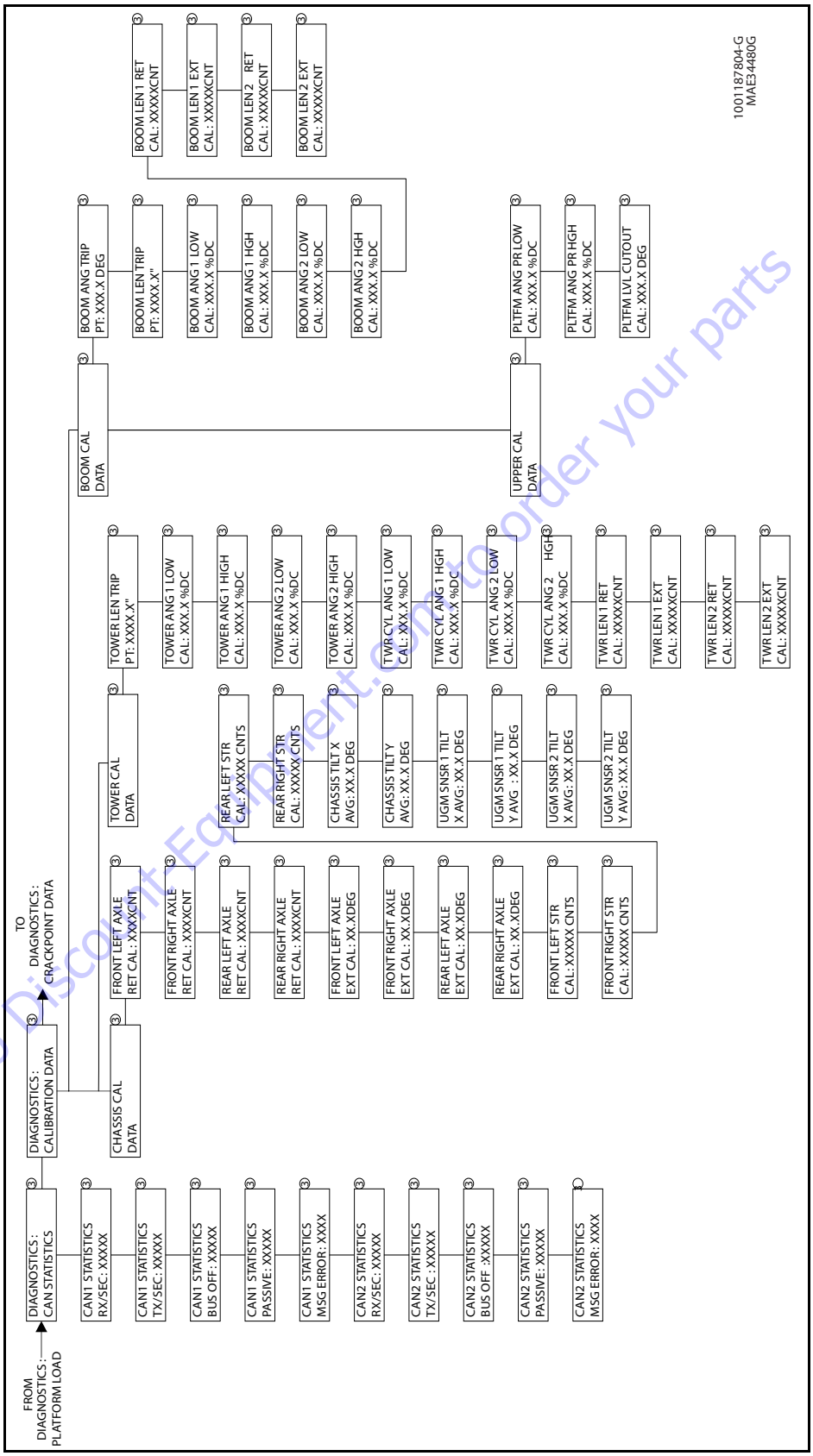





**Figure 6-14. Analyzer Flow Chart Software Version P1.6 - Sheet 9 of 10**


**Figure 6-15. Analyzer Flow Chart Software Version P1.6 - Sheet 10 of 10**

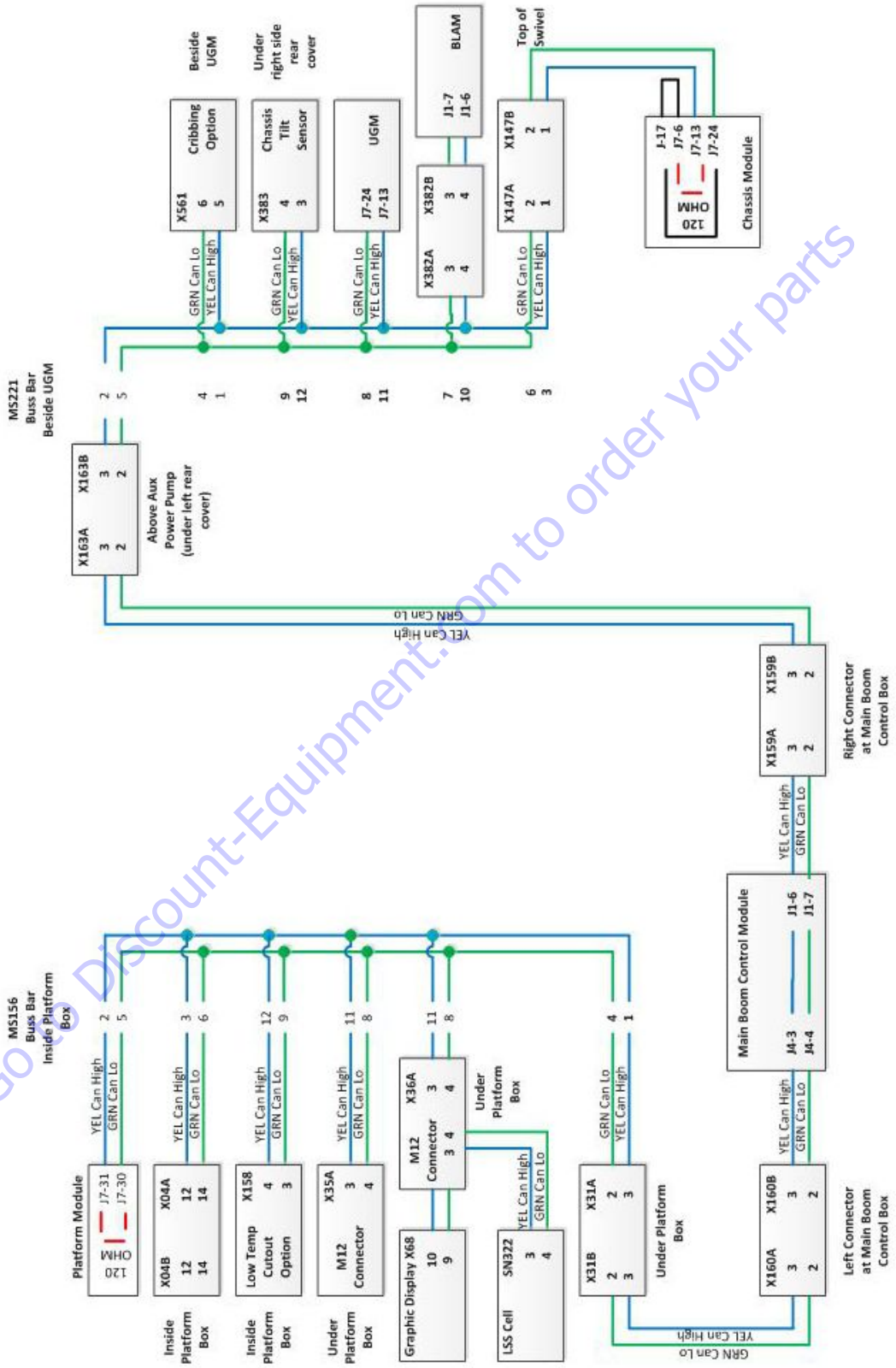



**Figure 6-16. CANBUS Circuit 1 Block Diagram**

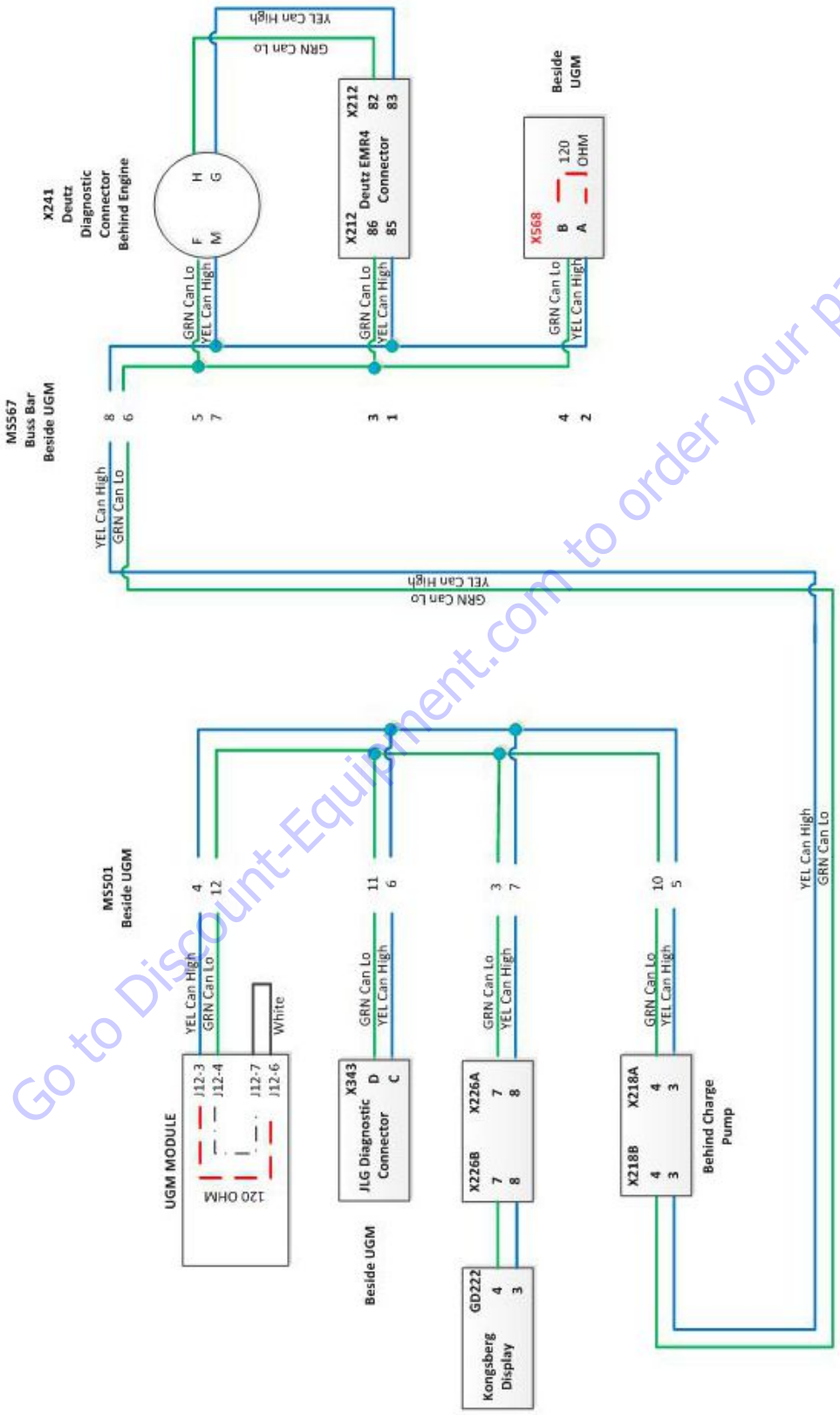
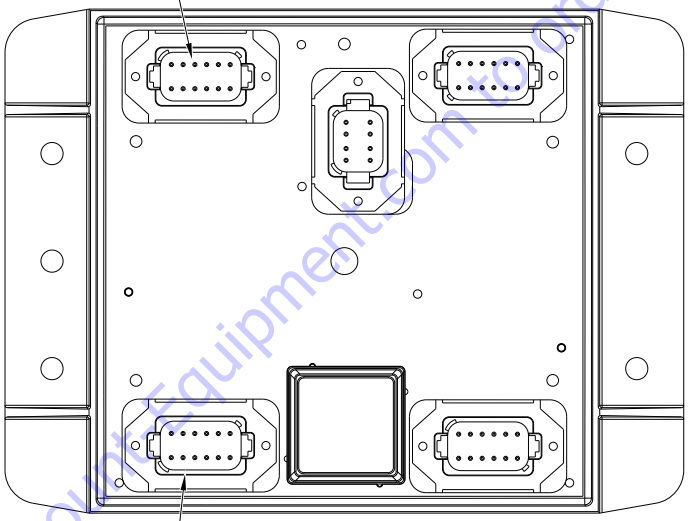



Figure 6-17. CANBUS Circuit 2 Block Diagram

| Connector | Pin | FUNCTION | TYPE | |
|---|---|---|---|---|
| J1 (Grey) | 1 | POWER FEED THRU TO J2-1 | Power | I/O |
| | 2 | POWER FEED THRU TO J2-2 | Power | I/O |
| | 3 | SIGNAL FEED THRU TO J2-4 | Digital | Input |
| | 4 | MASTER GROUND | Power | Input |
| | 5 | MASTER IGNITION | Power | Input |
| | 6 | CAN HIGH | Serial | I/O |
| | 7 | CAN LOW | Serial | I/O |
| | 8 | CAN SHIELD | Serial | I/O |
| | 9 | CAN TERM (CONNECT TO J1-10 TO ENGAGE) | Serial | I/O |
| | 10 | CAN TERM | Serial | I/O |
| | 11 | IGNITION | Power | Output |
| | 12 | GROUND | Power | Output |



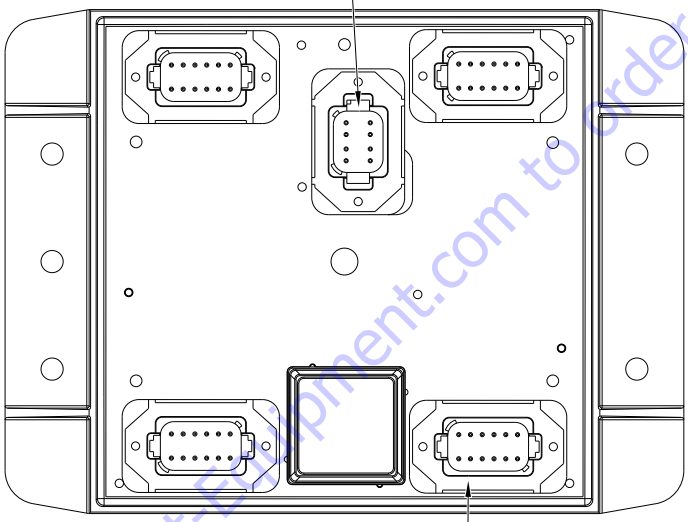
| Connector | Pin | FUNCTION | TYPE | |
|---|---|---|---|---|
| J3 (Green) | 1 | 5V ANALOG REFERENCE | Power | Output |
| | 2 | Ref Voltage from J3-1 | Analog | Input |
| | 3 | ANALOG GROUND | Power | Output |
| | 4 | 5V ANALOG REFERENCE | Power | Output |
| | 5 | Main Boom Length 2 | Analog | Input |
| | 6 | ANALOG GROUND | Power | Output |
| | 7 | 5V ANALOG REFERENCE | Power | Output |
| | 8 | Main Lift Down Rod Pressure Transducer | Analog | Input |
| | 9 | ANALOG GROUND | Power | Output |
| | 10 | 5V ANALOG REFERENCE | Power | Output |
| | 11 | Main Boom Length 1 | Analog | Input |
| | 12 | ANALOG GROUND | Power | Output |

1001200183-B
MAE37580B



**Figure 6-18. Boom Length Angle Pressure Module - Sheet 1 of 3**

| Connector | Pin | FUNCTION | TYPE | |
|---|---|---|---|---|
| J4 (Grey) | 1 | IGNITION | Power | Output |
| | 2 | GROUND | Power | Output |
| | 3 | CAN HIGH | Serial | I/O |
| | 4 | CAN LOW | Serial | I/O |
| | 5 | CAN SHIELD | Power | Input |
| | 6 | BOOTSTRAP MODE | Digital | Input |
| | 7 | IGNITION | Power | Output |
| | 8 | GROUND | Power | Output |



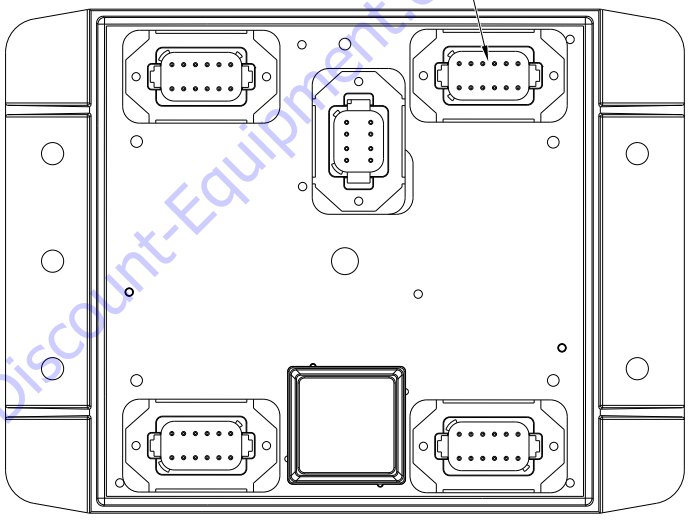
| Connector | Pin | FUNCTION | TYPE | |
|---|---|---|---|---|
| J5 (Brown) | 1 | Main Boom Lift Up | Digital | Output |
| | 2 | Main Boom Lift Down | Digital | Output |
| | 3 | Main Boom Telescope Flow Control | Digital | Output |
| | 4 | SPARE | Digital | Output |
| | 5 | Main Boom Telescope In | Digital | Output |
| | 6 | Main Boom Telescope Out | Digital | Output |
| | 7 | SPARE | Digital | Output |
| | 8 | SPARE | Digital | Output |
| | 9 | IGNITION | Power | Output |
| | 10 | RS232 RX | Serial | Input |
| | 11 | RS232 TX | Serial | Output |
| | 12 | GROUND | Power | Output |

1001200183-B
MAE34040B



**Figure 6-19. Boom Length Angle Pressure Module - Sheet 2 of 3**

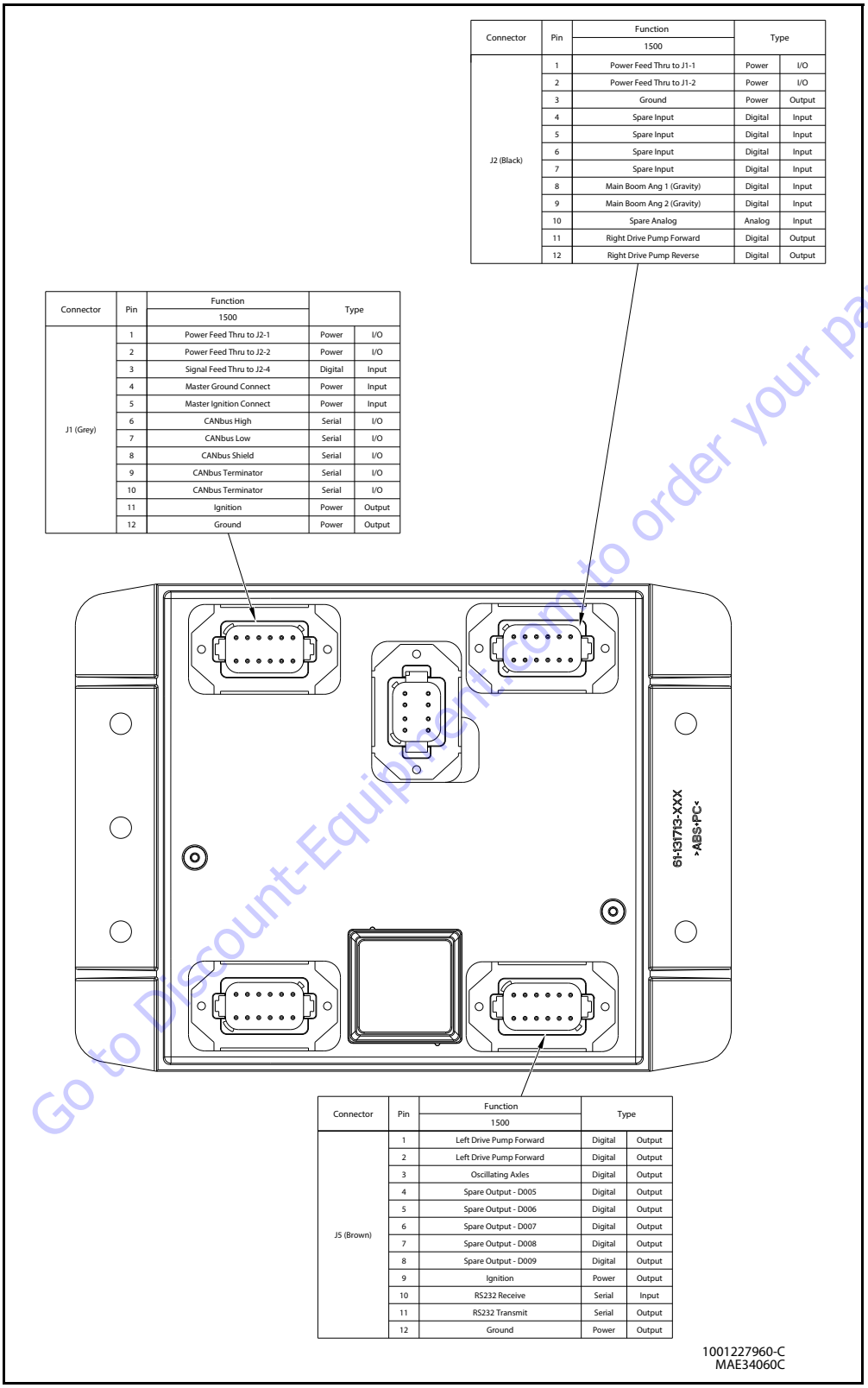
| | | | | |
|---|---|---|---|---|
| J2 (Black) | 1 | POWER FEED THRU TO J1-1 | Power | I/O |
| | 2 | POWER FEED THRU TO J1-2 | Power | I/O |
| | 3 | GROUND | Power | Output |
| | 4 | Main Lift Stuck Spool Proximity | Digital | Input |
| | 5 | SPARE | Digital | Input |
| | 6 | SPARE | Digital | Input |
| | 7 | Broken Cable Proximity | Digital | Input |
| | 8 | Main Boom Angle 1 Sensor | Digital | Input |
| | 9 | Main Boom Angle 2 Sensor | Digital | Input |
| | 10 | SPARE | Analog | Input |
| | 11 | SPARE | Digital | Output |
| | 12 | Main Lift Down Enable | Digital | Output |



1001200183-B
MAE34050B



**Figure 6-20. Boom Length Angle Pressure Module - Sheet 3 of 3**



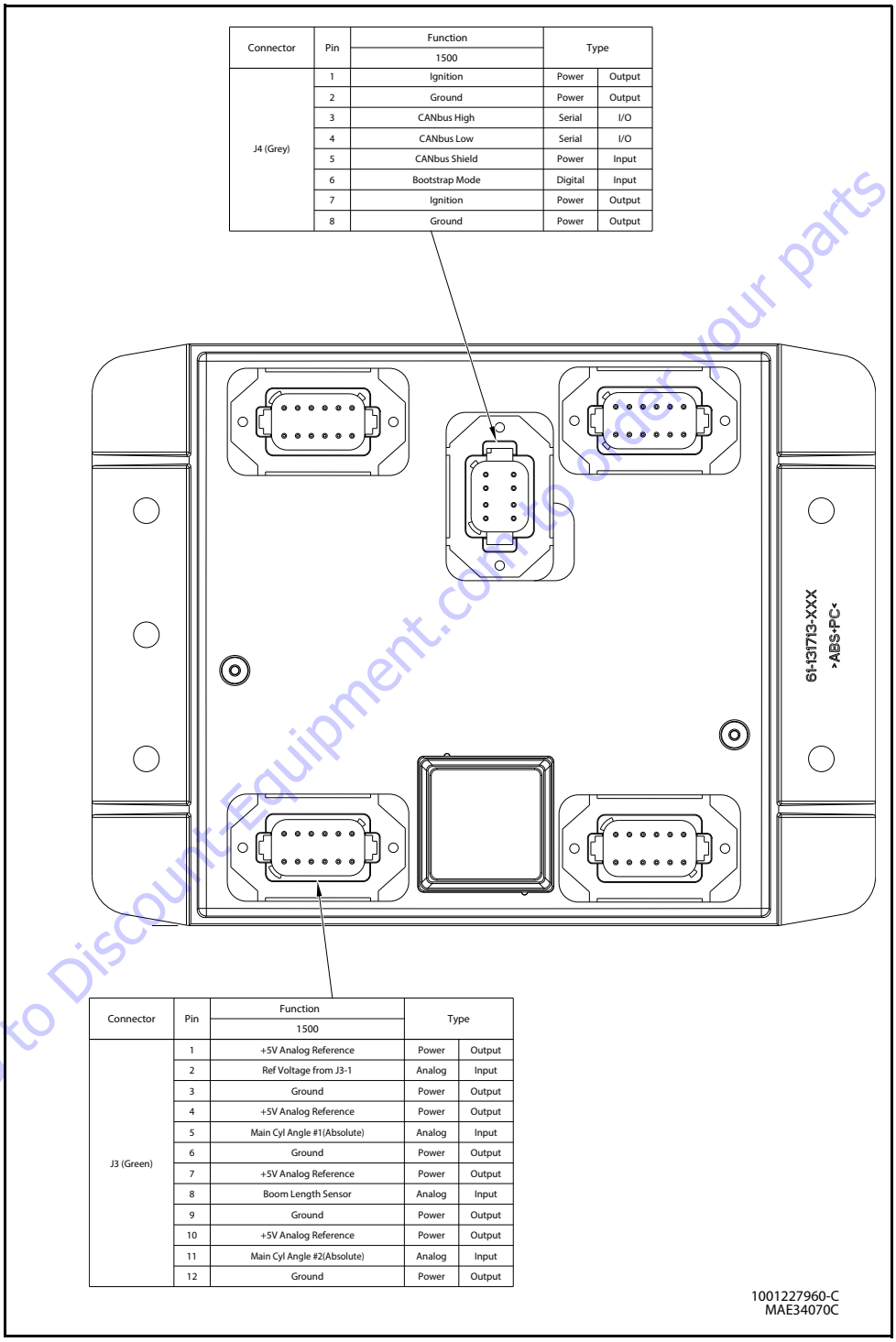

| Connector | Pin | Function 1500 | Type | |
|---|---|---|---|---|
| J2 (Black) | 1 | Power Feed Thru to J1-1 | Power | I/O |
| | 2 | Power Feed Thru to J1-2 | Power | I/O |
| | 3 | Ground | Power | Output |
| | 4 | Spare Input | Digital | Input |
| | 5 | Spare Input | Digital | Input |
| | 6 | Spare Input | Digital | Input |
| | 7 | Spare Input | Digital | Input |
| | 8 | Main Boom Ang 1 (Gravity) | Digital | Input |
| | 9 | Main Boom Ang 2 (Gravity) | Digital | Input |
| | 10 | Spare Analog | Analog | Input |
| | 11 | Right Drive Pump Forward | Digital | Output |
| | 12 | Right Drive Pump Reverse | Digital | Output |

| Connector | Pin | Function 1500 | Type | |
|---|---|---|---|---|
| J1 (Grey) | 1 | Power Feed Thru to J2-1 | Power | I/O |
| | 2 | Power Feed Thru to J2-2 | Power | I/O |
| | 3 | Signal Feed Thru to J2-4 | Digital | Input |
| | 4 | Master Ground Connect | Power | Input |
| | 5 | Master Ignition Connect | Power | Input |
| | 6 | CANbus High | Serial | I/O |
| | 7 | CANbus Low | Serial | I/O |
| | 8 | CANbus Shield | Serial | I/O |
| | 9 | CANbus Terminator | Serial | I/O |
| | 10 | CANbus Terminator | Serial | I/O |
| | 11 | Ignition | Power | Output |
| | 12 | Ground | Power | Output |

| Connector | Pin | Function 1500 | Type | |
|---|---|---|---|---|
| J5 (Brown) | 1 | Left Drive Pump Forward | Digital | Output |
| | 2 | Left Drive Pump Forward | Digital | Output |
| | 3 | Oscillating Axles | Digital | Output |
| | 4 | Spare Output - D005 | Digital | Output |
| | 5 | Spare Output - D006 | Digital | Output |
| | 6 | Spare Output - D007 | Digital | Output |
| | 7 | Spare Output - D008 | Digital | Output |
| | 8 | Spare Output - D009 | Digital | Output |
| | 9 | Ignition | Power | Output |
| | 10 | RS232 Receive | Serial | Input |
| | 11 | RS232 Transmit | Serial | Output |
| | 12 | Ground | Power | Output |



**Figure 6-21. BLAM Control Module - Sheet 1 of 2**



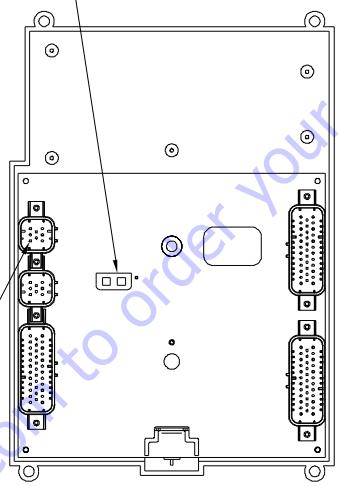

| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| | | 1500 | | |
| J4 (Grey) | 1 | Ignition | Power | Output |
| | 2 | Ground | Power | Output |
| | 3 | CANbus High | Serial | I/O |
| | 4 | CANbus Low | Serial | I/O |
| | 5 | CANbus Shield | Power | Input |
| | 6 | Bootstrap Mode | Digital | Input |
| | 7 | Ignition | Power | Output |
| | 8 | Ground | Power | Output |

| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| | | 1500 | | |
| J3 (Green) | 1 | +5V Analog Reference | Power | Output |
| | 2 | Ref Voltage from J3-1 | Analog | Input |
| | 3 | Ground | Power | Output |
| | 4 | +5V Analog Reference | Power | Output |
| | 5 | Main Cyl Angle #1(Absolute) | Analog | Input |
| | 6 | Ground | Power | Output |
| | 7 | +5V Analog Reference | Power | Output |
| | 8 | Boom Length Sensor | Analog | Input |
| | 9 | Ground | Power | Output |
| | 10 | +5V Analog Reference | Power | Output |
| | 11 | Main Cyl Angle #2(Absolute) | Analog | Input |
| | 12 | Ground | Power | Output |



**Figure 6-22. BLAM Control Module - Sheet 2 of 2**

| CONNECTOR | PIN | ASSIGNMENT | FUNCTION |
|---|---|---|---|
| J8 | 1 | N/A | GROUND |
| | 2 | N/A | BATTERY VOLTAGE |

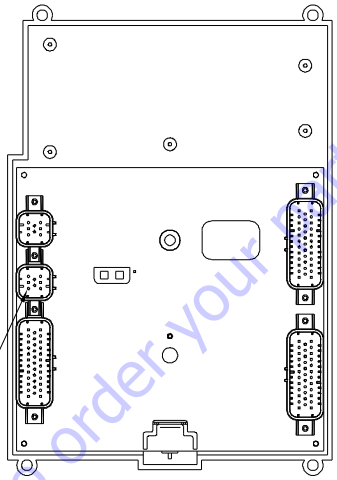


| CONNECTOR | PIN | ASSIGNMENT | FUNCTION |
|---|---|---|---|
| J5<br>NATURAL | 1 | Main Lift / Swing Joystick Power | SUPPLY VOLTAGE |
| | 2 | Main Lift Center Tap | ANALOG INPUT |
| | 3 | Main Lift Signal | ANALOG INPUT |
| | 4 | Swing Signal | ANALOG INPUT |
| | 5 | Swing Center Tap | ANALOG INPUT |
| | 6 | SPARE | ANALOG INPUT |
| | 7 | Main Lift / Swing Joystick Ground | GROUND |
| | 8 | SPARE | BLANK |



1001199483.D

**Figure 6-23. Platform Module - Sheet 1 of 5**



| CONNECTOR | PIN | ASSIGNMENT | FUNCTION |
|---|---|---|---|
| J6<br>BLACK | 1 | Drive / Steer Joystick Power | SUPPLY VOLTAGE |
| | 2 | Drive Center Tap | ANALOG INPUT |
| | 3 | Drive Signal | ANALOG INPUT |
| | 4 | SPARE | ANALOG INPUT |
| | 5 | Steer Left Switch | ANALOG INPUT |
| | 6 | Steer Right Swtich | ANALOG INPUT |
| | 7 | Drive / Steer Joystick Ground | GROUND |
| | 8 | SPARE | BLANK |

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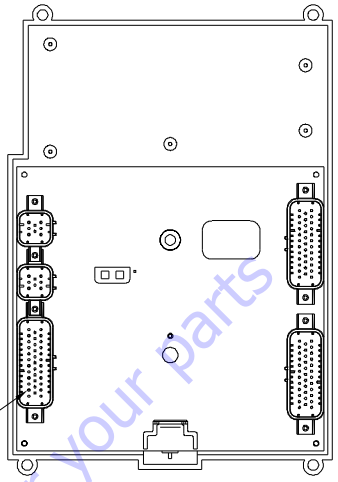
**Figure 6-24. Platform Module - Sheet 2 of 5**



| CONNECTOR | PIN | ASSIGNMENT | FUNCTION |
|---|---|---|---|
| J7 BLACK | 1 | Ground Mode | GROUND MODE |
| | 2 | Platform EMS | PLATFORM EMS |
| | 3 | Platform EMS to Ground Board | PLATFORM MODE |
| | 4 | CAN Based PF Level Sensor Power | BATTERY VOLTAGE |
| | 5 | Platform Rotate Left Valve | ME DIGITAL OUTPUT |
| | 6 | Platform Rotate Right Valve | ME DIGITAL OUTPUT |
| | 7 | LSS and Display Power | BATTERY VOLTAGE |
| | 8 | Footswitch Disengage | DIGITAL INPUT |
| | 9 | Generator Switch | DIGITAL INPUT |
| | 10 | Spare | +7 REFERENCE VOLTAGE |
| | 11 | Jib Angle Sensor Power | +5V REFERENCE VOLTAGE |
| | 12 | Spare | +5V REFERENCE VOLTAGE |
| | 13 | Spare | ANALOG INPUT |
| | 14 | Display Ground/PF LVL SENSOR GND | GROUND |
| | 15 | Platform Level Up Valve | HS DIGITAL OUTPUT |
| | 16 | Platform Level Down Valve | HS DIGITAL OUTPUT |
| | 17 | Spare | HS DIGITAL INPUT |
| | 18 | Skyguard Input 1 | HS DIGITAL INPUT |
| | 19 | Platform Alarm | LAMP OUTPUT |
| | 20 | Platform Alarm Ground | GROUND |
| | 21 | Primary Platform Level Sensor Ground | GROUND |
| | 22 | Skyguard Ground | GROUND |
| | 23 | Spare | ANALOG INPUT |
| | 24 | Spare | DIGITAL OUTPUT |
| | 25 | Jib Up Valve | ME DIGITAL OUTPUT |
| | 26 | Jib Down Valve | ME DIGITAL OUTPUT |
| | 27 | Jib Right Valve | ME DIGITAL OUTPUT |
| | 28 | Jib Left Valve | ME DIGITAL OUTPUT |
| | 29 | Valve Grounds | GROUND |
| | 30 | CAN Low | CAN LOW |
| | 31 | CAN High | CAN HIGH |
| | 32 | Spare | CAN SHIELD |
| | 33 | Backup Platform Level Sensor Ground | GROUND |
| | 34 | Not A Ground Has Internal PTC | GROUND |
| | 35 | Spare | ANALOG INPUT |

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**Figure 6-25. Platform Module - Sheet 3 of 5**

| CONNECTOR | PIN | ASSIGNMENT | FUNCTION |
|---|---|---|---|
| J2<br>BLUE | 1 | Jib Swing Right Switch | HS DIGITAL INPUT |
| | 2 | Jib Swing Left Switch | HS DIGITAL INPUT |
| | 3 | Foot Switch Power | BATTERY VOLTAGE |
| | 4 | Drive Orientation Override Switch | HS DIGITAL INPUT |
| | 5 | Platfrom Stowed Switch | HS DIGITAL INPUT |
| | 6 | Chassis Tilt Ind. | LAMP OUTPUT |
| | 7 | Function Enable Ind. | LAMP OUTPUT |
| | 8 | Vehicle System Distress Ind. | LAMP OUTPUT |
| | 9 | Creep Speed Ind. | LAMP OUTPUT |
| | 10 | Broken Cable Ind. | LAMP OUTPUT |
| | 11 | Platform Overload Ind. | LAMP OUTPUT |
| | 12 | 500# Capacity Ind. | LAMP OUTPUT |
| | 13 | 1000# Capacity Ind. | LAMP OUTPUT |
| | 14 | Axle Set Ind. | LAMP OUTPUT |
| | 15 | Generator On Ind. | LAMP OUTPUT |
| | 16 | Soft Touch / SkyGuard Ind. | LAMP OUTPUT |
| | 17 | Glow Plug Engaged Ind. | LAMP OUTPUT |
| | 18 | Lamp Return | GROUND |
| | 19 | BCS Ind. | LAMP OUTPUT |
| | 20 | Auto Level System Ind. | LAMP OUTPUT |
| | 21 | Low Fuel Ind. | LAMP OUTPUT |
| | 22 | Fuel 1/4 Full Ind. | LAMP OUTPUT |
| | 23 | Fuel 3/4 Full Ind. | LAMP OUTPUT |
| | 24 | Fuel 1/2 Full Ind. | LAMP OUTPUT |
| | 25 | Fuel Ind. Ground | GROUND |
| | 26 | Analyzer Power | ANALYZER POWER |
| | 27 | Analyzer Ground | ANALYZER GROUND |
| | 28 | Analyzer RS-232 Rx | ANALYZER RX |
| | 29 | Analyzer RS-232 Tx | ANALYZER TX |
| | 30 | Drive Orientation Ind. | LAMP OUTPUT |
| | 31 | SPARE | DIGITAL OUTPUT |
| | 32 | Soft Touch/ Skyguard Power | BATTERY VOLTAGE |
| | 33 | Generator Switch Power | BATTERY VOLTAGE |
| | 34 | Spare | BATTERY VOLTAGE |
| | 35 | Fuel Full Ind. | LAMP OUTPUT |

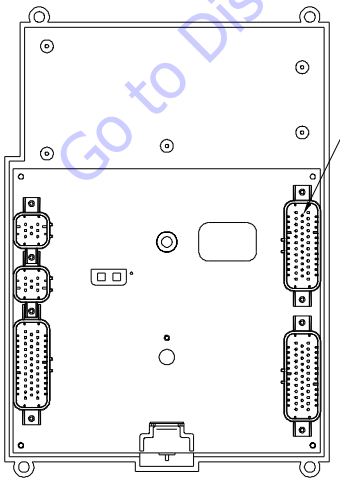

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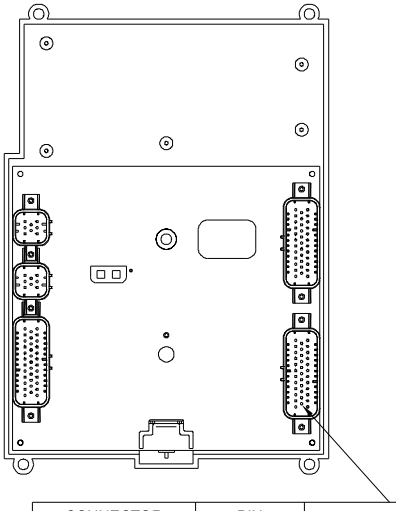
**Figure 6-26. Platform Module - Sheet 4 of 5**



| CONNECTOR | PIN | ASSIGNMENT | FUNCTION |
|---|---|---|---|
| J1<br>NATURAL | 1 | Tower Lift Up Switch | HS DIGITAL INPUT |
| | 2 | Tower Lift Down Switch | HS DIGITAL INPUT |
| | 3 | Skyguard Input 2 | HS DIGITAL INPUT |
| | 4 | Jib Stow | HS DIGITAL INPUT |
| | 5 | Main Tele In Switch | HS DIGITAL INPUT |
| | 6 | Main Tele Out Switch | HS DIGITAL INPUT |
| | 7 | Platform Rotate Right Switch | HS DIGITAL INPUT |
| | 8 | Platform Rotate Left Switch | HS DIGITAL INPUT |
| | 9 | Platform Level Up Switch | HS DIGITAL INPUT |
| | 10 | Platform Level Down Switch | HS DIGITAL INPUT |
| | 11 | Jib Up Switch | HS DIGITAL INPUT |
| | 12 | Jib Down Switch | HS DIGITAL INPUT |
| | 13 | Engine Start Switch | GROUND |
| | 14 | Auxiliary Power Switch | HS DIGITAL INPUT |
| | 15 | Crab Steer Select Switch | HS DIGITAL INPUT |
| | 16 | Coordinated Steer Select Switch | HS DIGITAL INPUT |
| | 17 | Jib Inline Switch N.C. | HS DIGITAL INPUT |
| | 18 | Soft Touch Input | BATTERY VOLTAGE |
| | 19 | 500/1000 LB Capacity Select | HS DIGITAL INPUT |
| | 20 | Boom Envelope Control Select | HS DIGITAL INPUT |
| | 21 | Front/Rear Axle Extend | HS DIGITAL INPUT |
| | 22 | Front/Rear Axle Retract | HS DIGITAL INPUT |
| | 23 | Platform Angle Sensor 1 (Gravity - PWM) | HS DIGITAL INPUT |
| | 24 | Platform Level Angle Sensor (Protractor - PWM) | HS DIGITAL INPUT |
| | 25 | Two Speed Valve (High Engine) | HS DIGITAL INPUT |
| | 26 | Torque Mode | HS DIGITAL INPUT |
| | 27 | Soft Touch / SkyGuard Override Button | HS DIGITAL INPUT |
| | 28 | Head / Tail Light Switch | HS DIGITAL INPUT |
| | 29 | Horn Button | HS DIGITAL INPUT |
| | 30 | Creep Switch | HS DIGITAL INPUT |
| | 31 | Jib Inline Switch N.O. | HS DIGITAL INPUT |
| | 32 | Speed Pump Potentiometer Signal | HS DIGITAL INPUT |
| | 33 | DUAL-FUEL SELECT | HS DIGITAL INPUT |
| | 34 | SPEED PUMP POTENTIOMETER REFERENCE VOLTAGE | +7 REFERENCE VOLTAGE |
| | 35 | SPEED PUMP POTENTIOMETER | ANALOG INPUT |

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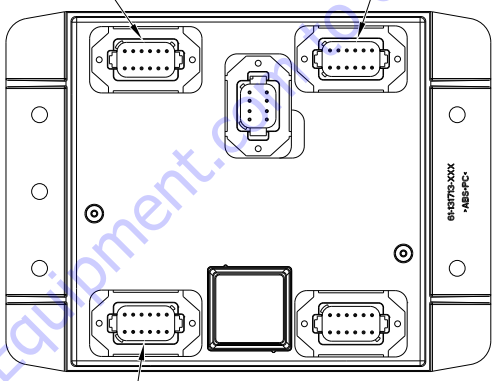
**Figure 6-27. Platform Module - Sheet 5 of 5**

| Connector | Pin | FUNCTION 1500 | Type | |
|---|---|---|---|---|
| J1 (Grey) | 1 | Power Feed Thru to J2-1 | Power | I/O |
| | 2 | Power Feed Thru to J2-2 | Power | I/O |
| | 3 | Signal Feed Thru to J2-4 | Digital | Input |
| | 4 | Master Ground Connect | Power | Input |
| | 5 | Master Ignition Connect | Power | Input |
| | 6 | CANbus High | Serial | I/O |
| | 7 | CANbus Low | Serial | I/O |
| | 8 | CANbus Shield | Serial | I/O |
| | 9 | CANbus Terminator | Serial | I/O |
| | 10 | CANbus Terminator | Serial | I/O |
| | 11 | Ignition | Power | Output |
| | 12 | Ground | Power | Output |

| Connector | Pin | FUNCTION 1500 | Type | |
|---|---|---|---|---|
| J2 (Black) | 1 | Power Feed Thru to J1-1 | Power | I/O |
| | 2 | Power Feed Thru to J1-2 | Power | I/O |
| | 3 | Ground | Power | Output |
| | 4 | Lock Pin NO Contact | Digital | Input |
| | 5 | Lock Pin NC Contact | Digital | Input |
| | 6 | Jib Transport #1 NO Contact | Digital | Input |
| | 7 | Jib Transport #1 NC Contact | Digital | Input |
| | 8 | Spare Input | Digital | Input |
| | 9 | Spare Input | Digital | Input |
| | 10 | Spare Analog Input | Analog | Input |
| | 11 | Jib Level Up | Digital | Output |
| | 12 | Jib Level Down | Digital | Output |




| Connector | Pin | FUNCTION 1500 | Type | |
|---|---|---|---|---|
| J3 (Green) | 1 | +5V Analog Reference | Power | Output |
| | 2 | Jib Level Angle #1 | Analog | Input |
| | 3 | Ground | Power | Output |
| | 4 | +5V Analog Reference | Power | Output |
| | 5 | Jib level Angle #2 | Analog | Input |
| | 6 | Ground | Power | Output |
| | 7 | +5V Analog Reference | Power | Output |
| | 8 | Jib Swing Angle #1 | Analog | Input |
| | 9 | Ground | Power | Output |
| | 10 | +5V Analog Reference | Power | Output |
| | 11 | Jib Swing Angle #2 | Analog | Input |
| | 12 | Ground | Power | Output |

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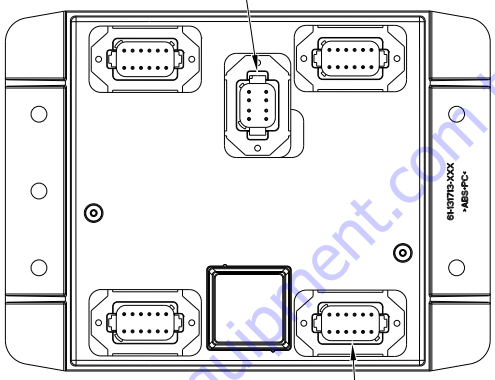
MAE34090C



**Figure 6-28. Jib Control Module - Sheet 1 of 2**

| Connector | Pin | FUNCTION 1500 | Type | |
|---|---|---|---|---|
| J4 (Grey) | 1 | Ignition | Power | Output |
| | 2 | Ground | Power | Output |
| | 3 | CANbus High | Serial | I/O |
| | 4 | CANbus Low | Serial | I/O |
| | 5 | CANbus Shield | Power | Input |
| | 6 | Bootstrap Mode | Digital | Input |
| | 7 | Ignition | Power | Output |
| | 8 | Ground | Power | Output |




| Connector | Pin | FUNCTION 1500 | Type | |
|---|---|---|---|---|
| J5 (Brown) | 1 | Jib Lift Up | Digital | Output |
| | 2 | Jib Lift Down | Digital | Output |
| | 3 | Jib Swing Right | Digital | Output |
| | 4 | Jib Swing Left | Digital | Output |
| | 5 | Jib Telescope In | Digital | Output |
| | 6 | Jib Telescope Out | Digital | Output |
| | 7 | Spare Output | Digital | Output |
| | 8 | Spare Output | Digital | Output |
| | 9 | Ignition | Power | Output |
| | 10 | RS232 Receive | Serial | Input |
| | 11 | RS232 Transmit | Serial | Output |
| | 12 | Ground | Power | Output |

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MAE34100C



**Figure 6-29. Jib Control Module - Sheet 2 of 2**

| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J1 (Natural) | 1 | Tower Lift Enable | DIGITAL | OUTPUT |
| | 2 | SPARE | DIGITAL | OUTPUT |
| | 3 | SPARE | DIGITAL | OUTPUT |
| | 4 | Tower Boom Transport Prox Ground | GROUND | INPUT |
| | 5 | SPARE | GROUND | INPUT |
| | 6 | Tower Telescope Enable | DIGITAL | OUTPUT |
| | 7 | Main Lift Down Override | DIGITAL | OUTPUT |
| | 8 | ECM Ground | GROUND | INPUT |
| | 9 | Generator Ground | GROUND | INPUT |
| | 10 | SPARE | DIGITAL | OUTPUT |
| | 11 | Start Request Signal | DIGITAL | OUTPUT |
| | 12 | Main Telescope In Override | DIGITAL | OUTPUT |
| | 13 | Auxiliary Power | DIGITAL | OUTPUT |
| | 14 | Tower Lift Barrel Side Pressure Sensor Signal #2 | ANALOG | INPUT |
| | 15 | Engine Battery Voltage Diagnostics | ANALOG | INPUT |
| | 16 | Tower Cylinder Angle Sensor #1 | FREQUENCY | INPUT |
| | 17 | Transducer Ground | GROUND | INPUT |
| | 18 | Transducer Ground | GROUND | INPUT |
| | 19 | SPARE | GROUND | INPUT |
| | 20 | Load Sense Cutoff Valve | DIGITAL | OUTPUT |
| | 21 | SPARE | DIGITAL | INPUT |
| | 22 | Generator/Welder (Option) | DIGITAL | OUTPUT |
| | 23 | Parking Brake | DIGITAL | OUTPUT |
| | 24 | SPARE | N/C | N/C |
| | 25 | SPARE | SERIAL | I/O |
| | 26 | SPARE | SERIAL | I/O |
| | 27 | Tower Cylinder Angle 2 Ground | GROUND | INPUT |
| | 28 | Analyzer Power | VOLTAGE | OUTPUT |
| | 29 | Analyzer RS-232 Rx | SERIAL | INPUT |
| | 30 | Analyzer RS-232 Tx | SERIAL | OUTPUT |
| | 31 | Analyzer Ground | GROUND | INPUT |
| | 32 | Alternator Excitation | DIGITAL | OUTPUT |
| | 33 | Tower Cylinder Angle 1 Ground | GROUND | INPUT |
| | 34 | SPARE | DIGITAL | INPUT |
| | 35 | SPARE | DIGITAL | INPUT |

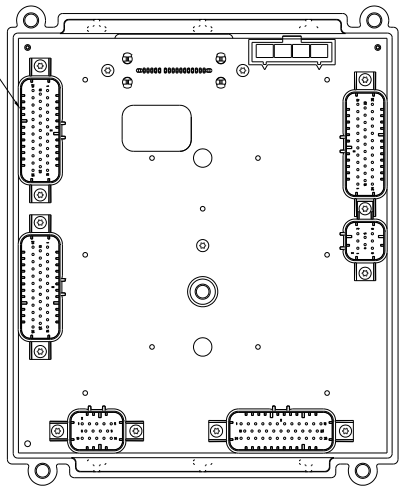

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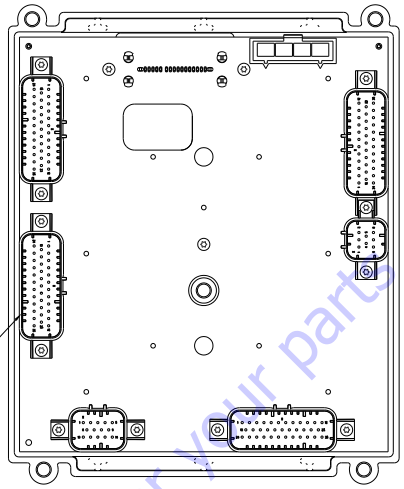
**Figure 6-30. UGM Module - Sheet 1 of 6**



| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J2 (Gray) | 1 | SPARE | DIGITAL | OUTPUT |
| | 2 | Chassis Enable Valve | DIGITAL | OUTPUT |
| | 3 | Platform Dump Valve | DIGITAL | OUTPUT |
| | 4 | Tower Telescope In Valve | DIGITAL | OUTPUT |
| | 5 | Basket Level Up Override | DIGITAL | OUTPUT |
| | 6 | Tele Valves Ground | GROUND | INPUT |
| | 7 | Basket Level Down Override | DIGITAL | OUTPUT |
| | 8 | Tower Telescope Flow Control Valve | DIGITAL | OUTPUT |
| | 9 | Main Lift Enable Aux Valve | DIGITAL | OUTPUT |
| | 10 | Main Lift Pilot Valve | DIGITAL | OUTPUT |
| | 11 | Tower Telescope Pilot Valve | DIGITAL | OUTPUT |
| | 12 | Warm Up Valve | DIGITAL | OUTPUT |
| | 13 | Main Dump Valve | DIGITAL | OUTPUT |
| | 14 | Lift Pilot/Main Dump Valves Ground | GROUND | INPUT |
| | 15 | Swing Left Valve | DIGITAL | OUTPUT |
| | 16 | Tower Tele Out Valve | DIGITAL | OUTPUT |
| | 17 | Chassis Enable Ground | GROUND | INPUT |
| | 18 | Swing Valves Ground | GROUND | INPUT |
| | 19 | Main Telescope Flow Control Override | DIGITAL | OUTPUT |
| | 20 | Tower Lift Flow Control Valve | DIGITAL | OUTPUT |
| | 21 | Tower Lift Down Valve | DIGITAL | OUTPUT |
| | 22 | SPARE | DIGITAL | OUTPUT |
| | 23 | Tower Lift Up Valve | DIGITAL | OUTPUT |
| | 24 | Hydraulic Oil Temp Switch | DIGITAL | INPUT |
| | 25 | Fuel Sensor | ANALOG | INPUT |
| | 26 | Head/Tail Light | DIGITAL | OUTPUT |
| | 27 | Alarm | DIGITAL | OUTPUT |
| | 28 | Alarm/ Fuel Sensor Ground | GROUND | INPUT |
| | 29 | Main Lift Flow Control Ground | GROUND | INPUT |
| | 30 | Lift Valves Ground | GROUND | INPUT |
| | 31 | SPARE | DIGITAL | OUTPUT |
| | 32 | Swing Right Valve | DIGITAL | OUTPUT |
| | 33 | Tower Lift Pilot | DIGITAL | OUTPUT |
| | 34 | Main Lift Flow Control Valve | DIGITAL | OUTPUT |
| | 35 | Swing Flow Control Valve | DIGITAL | OUTPUT |

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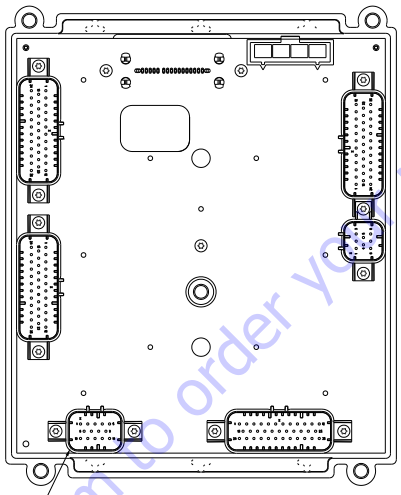
MAE34540H



**Figure 6-31. UGM Module - Sheet 2 of 6**



| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J3 (Black) | 1 | Tower Lift Flow Control Current FB | GROUND | INPUT |
| | 2 | Tower Tele Flow Control Current FB | GROUND | INPUT |
| | 3 | Hyd Warm Up/ Temp Sw Ground | GROUND | INPUT |
| | 4 | Boom Lift Flow Control FB | GROUND | INPUT |
| | 5 | Tower Telescope Enable Current FB | GROUND | INPUT |
| | 6 | Boom Lift Enable FB | GROUND | INPUT |
| | 7 | Alarm Power | VBAT | OUTPUT |
| | 8 | SPARE | DIGITAL | INPUT |
| | 9 | SPARE (Alternator Excitation Input) | DIGITAL | INPUT |
| | 10 | SPARE | DIGITAL | INPUT |
| | 11 | MSSO Con g | DIGITAL | INPUT |
| | 12 | Tower Lift Pressure Transducer #2 Barrel | VOLTAGE | OUTPUT |
| | 13 | Tower Lift Rod Side Pressure Sensor Signal #2 | ANALOG | INPUT |
| | 14 | Tower Lift Enable Current FB | GROUND | INPUT |

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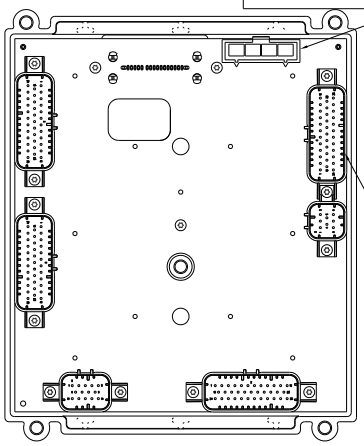
MAE34550H



**Figure 6-32. UGM Module - Sheet 3 of 6**

| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J8 (Black) | 1 | Ground from Battery | GROUND | INPUT |
| | 2 | Ground EMS | GROUND | INPUT |
| | 3 | Ground Shield | GROUND | OUTPUT |
| | 4 | SPARE | GROUND | OUTPUT |



| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J7 (Black) | 1 | Platform EMS | DIGITAL | INPUT |
| | 2 | Platform Mode | DIGITAL | INPUT |
| | 3 | Ground Mode | DIGITAL | INPUT |
| | 4 | Tower Lift Rod Pressure Sensor Signal #1 | ANALOG | INPUT |
| | 5 | SPARE | VOLTAGE | OUTPUT |
| | 6 | CAN Termination | TERM | I/O |
| | 7 | Pressure Reduction Pressure Sensor Signal | ANALOG | INPUT |
| | 8 | Tower Lift Barrel Side Pressure Sensor Signal #1 | ANALOG | INPUT |
| | 9 | Lift Pressure Sensor Ground | GROUND | INPUT |
| | 10 | Pressure Reduction Check Sensor Ground | GROUND | INPUT |
| | 11 | Tower Boom Transport N.C | DIGITAL | INPUT |
| | 12 | Broken Cable Switch | | INPUT |
| | 13 | CAN 1 Hi | SERIAL | I/O |
| | 14 | Ground Mode Out to Platform | DIGITAL | INPUT |
| | 15 | Footswitch Engage | DIGITAL | INPUT |
| | 16 | Lift Pressure Sensor Power | VOLTAGE | OUTPUT |
| | 17 | CAN Termination | TERM | I/O |
| | 18 | CAN Shield | GROUND | INPUT |
| | 19 | Broken Cable Switch Ground | GROUND | INPUT |
| | 20 | Tower Tele Rod Side Pressure Sensor Signal | ANALOG | INPUT |
| | 21 | Main Boom Transport Length N.O | DIGITAL | INPUT |
| | 22 | Main Boom Transport Length N.C | DIGITAL | INPUT |
| | 23 | Ground Control Enable | DIGITAL | INPUT |
| | 24 | CAN 1 Lo | SERIAL | I/O |
| | 25 | Tower Tele Pressure Transducer Ground | GROUND | INPUT |
| | 26 | Pressure Reduction Check Sensor Power | VOLTAGE | OUTPUT |
| | 27 | Tower Tele Pressure Transducer Power | VOLTAGE | OUTPUT |
| | 28 | SPARE | GROUND | INPUT |
| | 29 | Boom Length Switch Supply | VBAT | OUTPUT |
| | 30 | Ground Enable Supply | VBAT | OUTPUT |
| | 31 | SPARE | VBAT | OUTPUT |
| | 32 | Broken Cable Switch Supply | VBAT | OUTPUT |
| | 33 | Main Boom Transport Prox Supply | VBAT | OUTPUT |
| | 34 | Clearsky Power | VBAT | OUTPUT |
| | 35 | Tower Boom Transport N.O | DIGITAL | INPUT |

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MAE34560H



**Figure 6-33. UGM Module - Sheet 4 of 6**

| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J12 (Black) | 1 | SPARE | FREQUENCY | INPUT |
| | 2 | Tower Cylinder Angle Sensor #2 | FREQUENCY | INPUT |
| | 3 | CAN 2 Hi | SERIAL | I/O |
| | 4 | CAN 2 Lo | SERIAL | I/O |
| | 5 | MSSO Ground | GROUND | INPUT |
| | 6 | CAN 2 Terminator | TERM | I/O |
| | 7 | CAN 2 Terminator | TERM | I/O |
| | 8 | MSSO Switch | DIGITAL | INPUT |

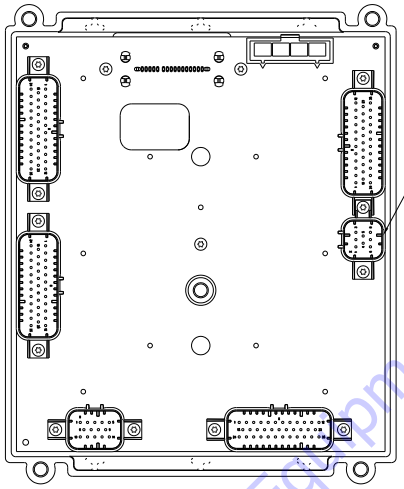



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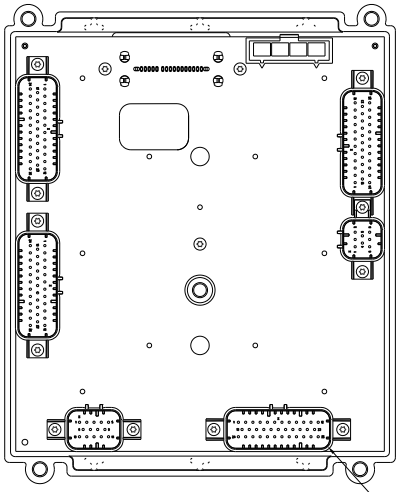
**Figure 6-34. UGM Module - Sheet 5 of 6**



| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J4 (Blue) | 1 | Axles Set Lamp | DIGITAL | OUTPUT |
| | 2 | 500# Capacity Lamp | DIGITAL | OUTPUT |
| | 3 | Boom control System Lamp | DIGITAL | OUTPUT |
| | 4 | Start Switch | DIGITAL | INPUT |
| | 5 | Basket Level Down | DIGITAL | INPUT |
| | 6 | Jib Swing Left Switch | DIGITAL | INPUT |
| | 7 | Main Tele In Switch | DIGITAL | INPUT |
| | 8 | Jib Lift Down | DIGITAL | INPUT |
| | 9 | SCR Cleaning Switch | DIGITAL | INPUT |
| | 10 | Tower Lift Up Switch | DIGITAL | INPUT |
| | 11 | Main Boom Angle Switch N.O | DIGITAL | INPUT |
| | 12 | SPARE | DIGITAL | OUTPUT |
| | 13 | SPARE | DIGITAL | OUTPUT |
| | 14 | Overload Lamp | DIGITAL | OUTPUT |
| | 15 | Glow Plug Indicator | DIGITAL | OUTPUT |
| | 16 | Auxiliary Power | DIGITAL | INPUT |
| | 17 | Basket Level Up | DIGITAL | INPUT |
| | 18 | SPARE | DIGITAL | INPUT |
| | 19 | Jib Up Switch | DIGITAL | INPUT |
| | 20 | Jib Swing Right Switch | DIGITAL | INPUT |
| | 21 | Tower Lift Down Switch | DIGITAL | INPUT |
| | 22 | Main Boom Angle Switch N.C | DIGITAL | INPUT |
| | 23 | Main Lift Up | DIGITAL | INPUT |
| | 24 | SPARE | VBAT | OUTPUT |
| | 25 | Switches Power | VBAT | OUTPUT |
| | 26 | HEST Lamp | DIGITAL | OUTPUT |
| | 27 | 1000# Capacity Lamp | DIGITAL | OUTPUT |
| | 28 | Engine Error Lamp | DIGITAL | OUTPUT |
| | 29 | SPARE | DIGITAL | OUTPUT |
| | 30 | Main Tele Out Switch | DIGITAL | INPUT |
| | 31 | Indicators Ground | GROUND | INPUT |
| | 32 | SPARE | GROUND | INPUT |
| | 33 | Main Lift Down Switch | DIGITAL | INPUT |
| | 34 | Swing Left Switch | DIGITAL | INPUT |
| | 35 | Swing Right Switch | DIGITAL | INPUT |

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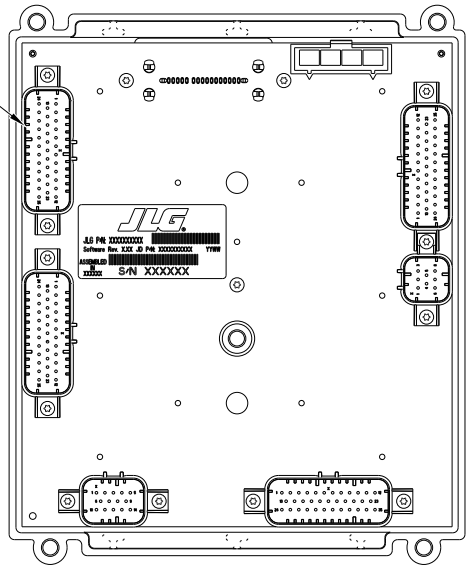
MAE34580H



**Figure 6-35. UGM Module - Sheet 6 of 6**

| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J1 (Natural) | 1 | SPARE | DIGITAL | OUTPUT |
| | 2 | SPARE | DIGITAL | OUTPUT |
| | 3 | SPARE | DIGITAL | OUTPUT |
| | 4 | SPARE | GROUND | INPUT |
| | 5 | SPARE | GROUND | INPUT |
| | 6 | SPARE | DIGITAL | OUTPUT |
| | 7 | SPARE | DIGITAL | OUTPUT |
| | 8 | GROUND | GROUND | INPUT |
| | 9 | GROUND | GROUND | INPUT |
| | 10 | SPARE | DIGITAL | OUTPUT |
| | 11 | SPARE | DIGITAL | OUTPUT |
| | 12 | SPARE | DIGITAL | OUTPUT |
| | 13 | SPARE | DIGITAL | OUTPUT |
| | 14 | LEFT FRONT AXLE SWING | ANALOG | INPUT |
| | 15 | RIGHT REAR AXLE SWING | ANALOG | INPUT |
| | 16 | TURNTABLE ANGLE #1 | FREQUENCY | INPUT |
| | 17 | SPARE | GROUND | INPUT |
| | 18 | SPARE | GROUND | INPUT |
| | 19 | SPARE | GROUND | INPUT |
| | 20 | SPARE | DIGITAL | OUTPUT |
| | 21 | SPARE | DIGITAL | INPUT |
| | 22 | SPARE | DIGITAL | OUTPUT |
| | 23 | SPARE | DIGITAL | OUTPUT |
| | 24 | SPARE | N/C | N/C |
| | 25 | SPARE | SERIAL | I/O |
| | 26 | SPARE | SERIAL | I/O |
| | 27 | SPARE | GROUND | INPUT |
| | 28 | ANALYZER POWER | VOLTAGE | OUTPUT |
| | 29 | ANALYZER RS-232 Rx | SERIAL | INPUT |
| | 30 | ANALYZER RS-232 Tx | SERIAL | OUTPUT |
| | 31 | ANALYZER GROUND | GROUND | INPUT |
| | 32 | SPARE | DIGITAL | OUTPUT |
| | 33 | SPARE | GROUND | INPUT |
| | 34 | SPARE | DIGITAL | INPUT |
| | 35 | SPARE | DIGITAL | INPUT |

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MAE34110G



**Figure 6-36. Chassis Module - Sheet 1 of 4**

| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J2 (Gray) | 1 | TWO SPEED | DIGITAL | OUTPUT |
| | 2 | SPARE | DIGITAL | OUTPUT |
| | 3 | SPARE | DIGITAL | OUTPUT |
| | 4 | FRONT AXLE SWING EXTEND | DIGITAL | OUTPUT |
| | 5 | REAR AXLE SWING EXTEND | DIGITAL | OUTPUT |
| | 6 | GROUND | GROUND | INPUT |
| | 7 | REAR AXLE SWING RETRACT | DIGITAL | OUTPUT |
| | 8 | RIGHT REAR STEER RIGHT | DIGITAL | OUTPUT |
| | 9 | LEFT REAR STEER RIGHT | DIGITAL | OUTPUT |
| | 10 | SPARE | DIGITAL | OUTPUT |
| | 11 | RIGHT FRONT STEER RIGHT | DIGITAL | OUTPUT |
| | 12 | SPARE | DIGITAL | OUTPUT |
| | 13 | BRAKE | DIGITAL | OUTPUT |
| | 14 | GROUND | GROUND | INPUT |
| | 15 | SPARE | DIGITAL | OUTPUT |
| | 16 | FRONT AXLE SWING RETRACT | DIGITAL | OUTPUT |
| | 17 | GROUND | GROUND | INPUT |
| | 18 | GROUND | GROUND | INPUT |
| | 19 | RIGHT REAR STEER LEFT | DIGITAL | OUTPUT |
| | 20 | LEFT REAR STEER LEFT | DIGITAL | OUTPUT |
| | 21 | SPARE | DIGITAL | OUTPUT |
| | 22 | RIGHT FRONT STEER LEFT | DIGITAL | OUTPUT |
| | 23 | SPARE | DIGITAL | OUTPUT |
| | 24 | SPARE | DIGITAL | INPUT |
| | 25 | FRONT RIGHT AXLE SWING | ANALOG | INPUT |
| | 26 | SPARE | DIGITAL | OUTPUT |
| | 27 | SPARE | DIGITAL | OUTPUT |
| | 28 | GROUND | GROUND | INPUT |
| | 29 | SPARE | GROUND | INPUT |
| | 30 | GROUND | GROUND | INPUT |
| | 31 | SPARE | DIGITAL | OUTPUT |
| | 32 | SPARE | DIGITAL | OUTPUT |
| | 33 | SPARE | DIGITAL | OUTPUT |
| | 34 | LEFT FRONT STEER LEFT | DIGITAL | OUTPUT |
| | 35 | LEFT FRONT STEER RIGHT | DIGITAL | OUTPUT |

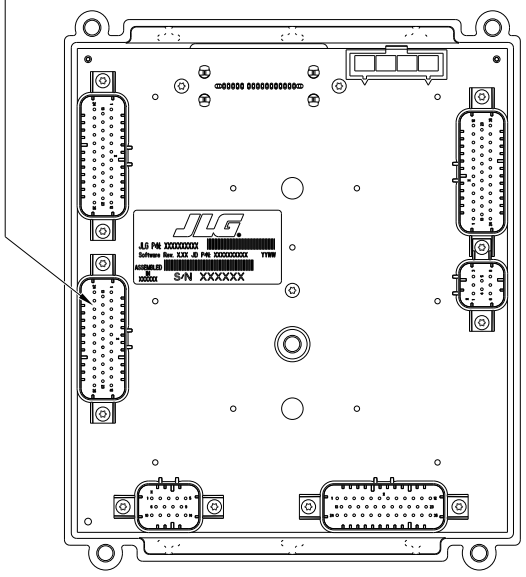


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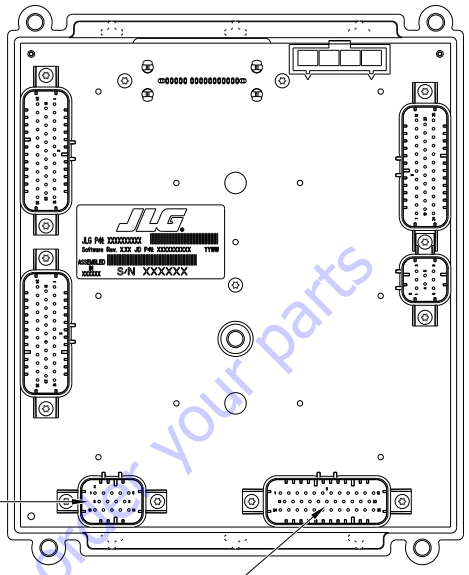
**Figure 6-37. Chassis Module - Sheet 2 of 4**



| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J3 (Black) | 1 | FRONT AXLE SWING RETURN | GROUND | INPUT |
| | 2 | REAR AXLE SWING RETURN | GROUND | INPUT |
| | 3 | GROUND | GROUND | INPUT |
| | 4 | SPARE | GROUND | INPUT |
| | 5 | SPARE | GROUND | INPUT |
| | 6 | SPARE | GROUND | INPUT |
| | 7 | SPARE | VBAT | OUTPUT |
| | 8 | SPARE | DIGITAL | INPUT |
| | 9 | SPARE | DIGITAL | INPUT |
| | 10 | SPARE | DIGITAL | INPUT |
| | 11 | SPARE | DIGITAL | INPUT |
| | 12 | ANALOG REF. VOLTAGE | VOLTAGE | OUTPUT |
| | 13 | LEFT REAR AXLE SWING | ANALOG | INPUT |
| | 14 | SPARE | GROUND | INPUT |

| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J4 (Blue) | 1 | SPARE | DIGITAL | OUTPUT |
| | 2 | SPARE | DIGITAL | OUTPUT |
| | 3 | SPARE | DIGITAL | OUTPUT |
| | 4 | SPARE | DIGITAL | INPUT |
| | 5 | SPARE | DIGITAL | INPUT |
| | 6 | SPARE | DIGITAL | INPUT |
| | 7 | SPARE | DIGITAL | INPUT |
| | 8 | SPARE | DIGITAL | INPUT |
| | 9 | SPARE | DIGITAL | INPUT |
| | 10 | SPARE | DIGITAL | INPUT |
| | 11 | SPARE | DIGITAL | INPUT |
| | 12 | SPARE | DIGITAL | OUTPUT |
| | 13 | SPARE | DIGITAL | OUTPUT |
| | 14 | SPARE | DIGITAL | OUTPUT |
| | 15 | SPARE | DIGITAL | OUTPUT |
| | 16 | SPARE | DIGITAL | INPUT |
| | 17 | SPARE | DIGITAL | INPUT |
| | 18 | SPARE | DIGITAL | INPUT |
| | 19 | SPARE | DIGITAL | INPUT |
| | 20 | SPARE | DIGITAL | INPUT |
| | 21 | SPARE | DIGITAL | INPUT |
| | 22 | SPARE | DIGITAL | INPUT |
| | 23 | SPARE | DIGITAL | INPUT |
| | 24 | SPARE | VBAT | OUTPUT |
| | 25 | SPARE | VBAT | OUTPUT |
| | 26 | SPARE | DIGITAL | OUTPUT |
| | 27 | SPARE | DIGITAL | OUTPUT |
| | 28 | SPARE | DIGITAL | OUTPUT |
| | 29 | SPARE | DIGITAL | OUTPUT |
| | 30 | SPARE | DIGITAL | INPUT |
| | 31 | SPARE | GROUND | INPUT |
| | 32 | SPARE | GROUND | INPUT |
| | 33 | SPARE | DIGITAL | INPUT |
| | 34 | SPARE | DIGITAL | INPUT |
| | 35 | SPARE | DIGITAL | INPUT |

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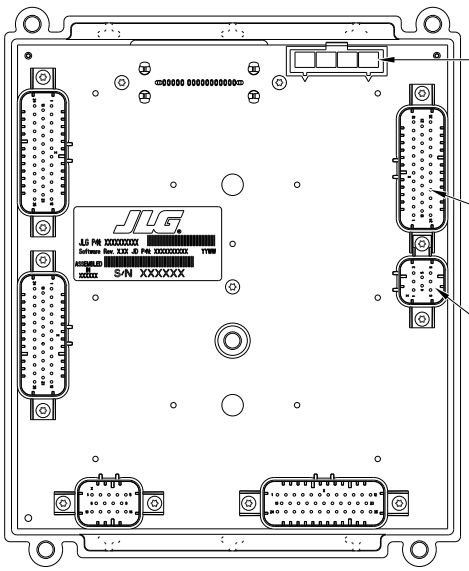
MAE34130G



**Figure 6-38. Chassis Module - Sheet 3 of 4**



| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J8 (Black) | 1 | GROUND FROM BATTERY | GROUND | INPUT |
| | 2 | POWER FROM BATTERY | POWER | INPUT |
| | 3 | SENSOR SHIELD | GROUND | OUTPUT |
| | 4 | SPARE | POWER | OUTPUT |

| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J7 (Black) | 1 | SPARE | DIGITAL | INPUT |
| | 2 | SPARE | DIGITAL | INPUT |
| | 3 | SPARE | DIGITAL | INPUT |
| | 4 | RIGHT FRONT STEER | ANALOG | INPUT |
| | 5 | REFERENCE VOLTAGE | VOLTAGE | OUTPUT |
| | 6 | CAN TERMINATION | TERM | I/O |
| | 7 | LEFT FRONT STEER | ANALOG | INPUT |
| | 8 | LEFT REAR STEER | ANALOG | INPUT |
| | 9 | GROUND | GROUND | INPUT |
| | 10 | GROUND | GROUND | INPUT |
| | 11 | DRIVE ORIENTATION SWITCH | DIGITAL | INPUT |
| | 12 | SPARE | | INPUT |
| | 13 | CAN HI | SERIAL | I/O |
| | 14 | SPARE | DIGITAL | INPUT |
| | 15 | BRAKE RELEASE FROM UGM | DIGITAL | INPUT |
| | 16 | REFERENCE VOLTAGE | VOLTAGE | OUTPUT |
| | 17 | CAN TERMINATION | TERM | I/O |
| | 18 | CAN SHEILD | GROUND | INPUT |
| | 19 | SPARE | GROUND | INPUT |
| | 20 | RIGHT REAR STEER | ANALOG | INPUT |
| | 21 | SPARE | DIGITAL | INPUT |
| | 22 | SPARE | DIGITAL | INPUT |
| | 23 | SPARE | DIGITAL | INPUT |
| | 24 | CAN LO | SERIAL | I/O |
| | 25 | GROUND | GROUND | INPUT |
| | 26 | REFERENCE VOLTAGE | VOLTAGE | OUTPUT |
| | 27 | REFERENCE VOLTAGE | VOLTAGE | OUTPUT |
| | 28 | GROUND | GROUND | INPUT |
| | 29 | VBAT | VBAT | OUTPUT |
| | 30 | SPARE | VBAT | OUTPUT |
| | 31 | SPARE | VBAT | OUTPUT |
| | 32 | SPARE | VBAT | OUTPUT |
| | 33 | SPARE | VBAT | OUTPUT |
| | 34 | SPARE | VBAT | OUTPUT |
| | 35 | SPARE | DIGITAL | INPUT |

| Connector | Pin | Function | Type | |
|---|---|---|---|---|
| J12 (Black) | 1 | TURNTABLE ANGLE #2 | FREQUENCY | INPUT |
| | 2 | GROUND | FREQUENCY | INPUT |
| | 3 | SPARE | SERIAL | I/O |
| | 4 | SPARE | SERIAL | I/O |
| | 5 | SPARE | GROUND | INPUT |
| | 6 | SPARE | TERM | I/O |
| | 7 | SPARE | TERM | I/O |
| | 8 | SPARE | DIGITAL | INPUT |

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MAE34140G



**Figure 6-39. Chassis Module - Sheet 4 of 4**

## 6.5 MACHINE CONFIGURATION PROGRAMMING INFORMATION

**Table 6-2. Machine Configuration Programming Information - Version P1.6**

| Configuration Label/ Digit | Number | Description | Default Number |
|---|---|---|---|
| ***NOTE:*** *The machine configuration must be completed before any personality settings can be changed. Changing the personality settings first and then changing the model number of the machine configuration will cause the personality settings to return to default values.*<br><br>*- The items marked in **BOLD** text on this sheet represent a new board that has never been configured.* | | | |
| | | | |
| MODEL NUMBER: 1 | 0 | No Model | **1** |
| | **1** | **1500AJP** | |
| | | | |
| MARKET: 2 | **0** | **ANSI USA** | **0** |
| | 1 | ANSI EXPORT | |
| | 2 | CSA | |
| | 3 | CE | |
| | 4 | AUSTRALIA | |
| | 5 | JAPAN | |
| | | | |
| ENGINE: 3 | 0 | DEUTZ ECM T4i: Engine Control Module (Tier 4 Interim, LRC) | **1** |
| | **1** | **DEUTZ ECM T4F: Engine Control Module (Tier 4 Final, HRC)** | |
| | | | |
| FUEL CUTOUT: 4 | **0** | **RESTART: Engine allowed to be restarted multiple times when very low fuel level is reached.** | **0** |
| | 1 | ONE RESTART: Engine allowed to be restarted once for 2 minutes when very low fuel level is reached. | |
| | 2 | ENGINE STOP: Engine not able to restart when very low fuel level is reached. | |

**Table 6-2. Machine Configuration Programming Information - Version P1.6**

| Configuration Label/ Digit | Number | Description | Default Number |
|---|---|---|---|
| CHASSIS TILT: 5 | **1** | **5 DEGREES + DRV CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also cuts out drive.** | **1** |
| | 2 | 4 DEGREES + DRV CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also cuts out drive. | |
| | 3 | 3 DEGREES + DRV CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also cuts out drive. | |
| | 4 | 4 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. | |
| | 5 | 3 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. | |
| | 6 | 5 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. | |
| | | | |
| SKYGUARD: 6 | 0 | NO: Skyguard is not installed. | **1** |
| | **1** | **YES: Skyguard is installed.** | |
| | | | |
| SOFT TOUCH: 7 | **0** | **NO: Soft Touch is not installed.** | **0** |
| | 1 | YES: Soft Touch is installed. | |
| | | | |
| GEN SET/WELDER: 8 | **0** | **NO: No generator installed.** | **0** |
| | 1 | BELT DRIVE: Belt driven setup. | |
| | | | |
| GEN SET CUTOUT: 9* | **0** | **MOTION ENABLED: Motion enabled when generator is ON.** | **0** |
| | 1 | MOTION CUTOUT: Motion cutout in platform mode only. | |
| *Only visible if Gen Set / Welder Menu selection is not 0. | | | |
| | | | |
| H & T LIGHTS: 10 | **0** | **NO: No head and tail lights installed.** | **0** |
| | 1 | YES: Head and tail lights installed. | |
| | | | |
| LOAD SYSTEM: 11* | **0** | **NO: No load sensor installed.** | **0** |
| | 1 | CUTOUT PLATFORM: All functions cutout, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). | |
| | 2 | CUTOUT ALL: All functions cutout, flash overload light (500mS on, 500mS off), platform alarm beeps (5 sec ON, 2 sec OFF). | |
| *Only visible under certain market selections. | | | |
| *Certain market selections will limit load system options or alter default setting. | | | |

**Table 6-2. Machine Configuration Programming Information - Version P1.6**

| Configuration Label/ Digit | Number | Description | Default Number |
|---|---|---|---|
| FUNCTION CUTOUT: 12* | **0** | **NO: No drive cutout.** | **0** |
| | 1 | BOOM CUTOUT: Boom function cutout while driving above elevation. | |
| | 2 | DRIVE CUTOUT: Drive cutout above elevation. | |
| *Only visible under certain market selections. | | | |
| *Certain market selections will limit function cutout options or alter default setting. | | | |
| | | | |
| GROUND ALARM: 13* | 0 | NO: No ground alarm installed. | **3** |
| | 1 | DRIVE: Travel alarm sounds when the drive function is active (Option). | |
| | 2 | DESCENT: Descent alarm sounds when lift down is active (Option). | |
| | **3** | **MOTION: Motion alarm sounds when any function is active (Option).** | |
| | | | |
| DISPLAY UNITS: 14* | 0 | METRIC: units selection. (Deg. C, KPA, Kg.) | **1** |
| | **1** | **IMPERIAL units selection. (Deg. F, PSI, Lbs.)** | |
| *Certain market selections will alter default setting. | | | |
| | | | |
| CLEARSKY: 15 | **0** | **NO: ClearSky Telematics system not installed.** | **0** |
| | 1 | YES: ClearSky Telematics system installed. | |
| | | | |
| ALERT BEACON: 16 | **0** | **OFF FOR CREEP** | **0** |
| | 1 | 20FPS FOR CREEP | |
| | | | |
| TEMP CUTOUT: 17* | **0** | NO: No temperature cutout | **0** |
| | 1 | YES: Temperature cutout enabled | |
| *Certain market selections will alter default setting. | | | |
| | | | |
| PLAT LVL OVR CUT: 18 | **0** | NO: Platform Level Manual Override Cutout disabled | **0** |
| | 1 | YES: Platform Level Manual Override Cutout enabled | |
| | | | |
| WATER IN FUEL SENSOR: 19* | **0** | NO: Water In Fuel shutdown disabled | **0** |
| | 1 | YES: Water In Fuel shutdown enabled | |
| *Only visible under certain market selections.<br>*Certain market selections will limit function cutout options or alter default setting. | | | |
| | | | |
| CRIBBING: 20* | **0** | NO: Cribbing disabled | **0** |
| | 1 | YES: Cribbing enabled | |
| *Only visible under certain market selections.<br>*Certain market selections will limit function cutout options or alter default setting | | | |

**Table 6-2. Machine Configuration Programming Information - Version P1.6**

| Configuration Label/ Digit | Number | Description | Default Number |
|---|---|---|---|
| DISPLAY LANGUAGE: 21 | **0** | **ENGLISH** | **0** |
| | 1 | SPANISH | |
| | 2 | EURO PORTUGUESE | |
| | 3 | BRAZILIAN PORTUGUESE | |
| | 4 | FRENCH | |
| | 5 | GERMAN | |
| | 6 | DUTCH | |
| | 7 | ITALIAN | |
| | 8 | SIMPLIFIED CHINESE | |
| | 9 | JAPANESE | |
| | 10 | KOREAN | |

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[6] **Table 6-3. Machine Configuration programming Settings - Version P1.6**

| 1500AJP | ANSI USA | ANSI Export | CSA | CE | Australia | Japan |
|---|---|---|---|---|---|---|
| Model Number | **1** | **1** | **1** | **1** | **1** | **1** |
| Market | **0** | **1** | **2** | **3** | **4** | **5** |
| Engine | 0 | 0 | 0 | 0 | **0** | 0 |
| | **1** | **1** | **1** | **1** | 1 | **1** |
| Fuel Cutout | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 |
| | 2 | 2 | 2 | 2 | 2 | 2 |
| Chassis Tilt | **1** | **1** | **1** | **1** | **1** | **1** |
| | 2 | 2 | 2 | 2 | 2 | 2 |
| | 3 | 3 | 3 | 3 | 3 | 3 |
| | 4 | 4 | 4 | 4 | 4 | 4 |
| | 5 | 5 | 5 | 5 | 5 | 5 |
| | 6 | 6 | 6 | 6 | 6 | 6 |
| Skyguard | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 |
| Soft Touch | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 |
| Gen Set/Welder | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 |
| Gen Set Cutout | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 |
| Head & Tail lights | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 |
| Load System | 0 | **0** | 0 | 0 | 0 | **0** |
| | **1** | 1 | **1** | X | **1** | 1 |
| | 2 | 2 | 2 | **2** | X | 2 |
| Function Cutout | **0** | **0** | **0** | X | **0** | **0** |
| | 1 | 1 | 1 | **1** | 1 | 1 |
| | 2 | 2 | 2 | X | 2 | 2 |
| Ground Alarm | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 |
| | 2 | 2 | 2 | 2 | 2 | 2 |
| | **3** | **3** | **3** | **3** | **3** | **3** |
| Display Units | 0 | 0 | **0** | **0** | **0** | **0** |
| | **1** | **1** | 1 | 1 | 1 | 1 |
| Clearsky | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 |
| Alert Beacon | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 |

**Table 6-3. Machine Configuration programming Settings - Version P1.6**

| 1500AJP | ANSI USA | ANSI Export | CSA | CE | Australia | Japan |
|---|---|---|---|---|---|---|
| Temp Cutout | X | **0** | X | **0** | X | X |
| | X | 1 | X | 1 | X | X |
| Plat Lvl Ovr Cut | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 |
| Water In Fuel | X | **0** | X | X | X | X |
| | X | 1 | X | X | X | X |
| Cribbing | **0** | X | X | X | X | X |
| | 1 | X | X | X | X | X |
| Language | **0** | **0** | **0** | **0** | **0** | **0** |
| | 1 | 1 | 1 | 1 | 1 | 1 |
| | 2 | 2 | 2 | 2 | 2 | 2 |
| | 3 | 3 | 3 | 3 | 3 | 3 |
| | 4 | 4 | 4 | 4 | 4 | 4 |
| | 5 | 5 | 5 | 5 | 5 | 5 |
| | 6 | 6 | 6 | 6 | 6 | 6 |
| | 7 | 7 | 7 | 7 | 7 | 7 |
| | 8 | 8 | 8 | 8 | 8 | 8 |
| | 9 | 9 | 9 | 9 | 9 | 9 |
| | 10 | 10 | 10 | 10 | 10 | 10 |

**BOLD TEXT** indicates the default setting. Plain text indicates another available selection.

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## 6.6 MACHINE PERSONALITY SETTINGS AND SPEEDS

**Table 6-4. Machine Personality Settings and Speeds**

| Submenu (Displayed on Analyzer 1st Line) | Parameter (Displayed on Analyzer 2nd Line) | Description | Range | Default Value | Times (Seconds) |
|---|---|---|---|---|---|
| DRIVE: | | | | | |
| DRIVE: | ACCEL X.Xs | Displays/adjusts drive acceleration | 0.1 to 3.0 sec | 2 | |
| | DECEL X.Xs | Displays/adjusts drive deceleration | 0.1 to 2.0 sec | 1 | |
| | FWD MIN XX% | Displays/adjusts minimum forward drive speed | 1 to 20% | 1 | |
| | FWD MAX XXX% | Displays/adjusts maximum forward drive speed | 50 to 100% | 100 | 47-50 (see orientation) |
| | REV MIN XX% | Displays/adjusts minimum reverse drive speed | 1 to 20% | 1 | |
| | REV MAX XX% | Displays/adjusts maximum reverse drive speed | 50 to 100% | 100 | |
| | ELEV. MAX XX% | Displays/adjusts maximum drive speed<br>NOTE: used when elevation cutout switches are limiting maximum speed | 15 to 28% | 18 | 170-188 (see orientation) |
| | CREEP SCALE XX% | Displays/adjusts maximum drive speed<br>NOTE: used when creep switch on pump pot is active | 15 to 28% | 180 | 79-87 (see orientation) |
| BOOM LIFT: | | | | | |
| BOOM LIFT: | ACCEL X.Xs | Displays/adjusts main lift acceleration | 0.1 to 3.0 sec | 1.0 | |
| | DECEL X.Xs | Displays/adjusts main lift deceleration | 0.1 to 2.0 sec | 0.5 | |
| BOOM LIFT UP | CREEP SCALE XX% | Displays/adjusts maximum main lift up speed<br>NOTE: used when creep switch on pump pot is active | 0 to 50% | 35 | |
| BOOM LIFT DOWN | CREEP SCALE XX% | Displays/adjusts maximum main lift down speed<br>NOTE: used when creep switch on pump pot is active | 0 to 50% | 40 | |
| | | Desired MAIN BOOM LIFT UP time | | | 70-90 (see orientation) |
| | | Desired MAIN BOOM LIFT DOWN time | | | 70-90 (see orientation) |
| | | Desired QUICKSTICK UP time | | | 165-195 (see orientation) |
| | | Desired QUICKSTICK DOWN time | | | 165-195(see orientation) |
| TT SWING: | | | | | |
| SWING: | ACCEL X.Xs | Displays/adjusts swing acceleration | 0.1 to 3.0 sec | 2 | |
| | DECEL X.Xs | Displays/adjusts swing deceleration | 0.1 to 2.0 sec | 1.5 | |
| | LEFT MIN XX% | Displays/adjusts minimum swing left speed | 1 to 50% | 25 | |
| | LEFT MAX XXX% | Displays/adjusts maximum swing left speed | 40 to 80% | 60 | 105-125 (see orientation) |
| SWING LEFT | CREEP SCALE XX% | Displays/adjusts maximum swing left speed<br>NOTE: used when creep switch on pump pot is active | 0 to 50% | 25 | |
| SWING | RIGHT MINXX% | Displays/adjusts minimum swing right speed | 1 to 50% | 25 | |
| | RIGHT MAX XXX% | Displays/adjusts maximum swing right speed | 40 to 80% | 60 | 105-125 (see orientation) |
| SWING RIGHT | CREEP SCALE XX% | Displays/adjusts maximum swing right speed<br>NOTE: used when creep switch on pump pot is active | 0 to 50% | 25 | |
| TOWER LIFT: | | | | | |
| TOWER LIFT | ACCEL X.Xs | Displays/adjusts main lift acceleration | 0.1 to 3.0 sec | 1 | |
| | DECEL X.Xs | Displays/adjusts main lift deceleration | 0.1 to 2.0 sec | 0.5 | |
| | | Desired TOWER BOOM LIFT UP time | | | 130-150 (see orientation) |
| | | Desired TOWER BOOM LIFT DOWN time | | | 145-165 (see orientation) |

**Table 6-4. Machine Personality Settings and Speeds**

| Submenu (Displayed on Analyzer 1st Line) | Parameter (Displayed on Analyzer 2nd Line) | Description | Range | Default Value | Times (Seconds) |
|---|---|---|---|---|---|
| BOOM TELE: | | | | | |
| BOOM TELE | ACCEL X.Xs | Displays/adjusts main telescope acceleration | 0.1 to 3.0 sec | 1.5 | |
| | DECEL X.Xs | Displays/adjusts main telescope deceleration | 0.1 to 2.0 sec | 0.5 | |
| | CREEP SCALE XX% | Displays/adjusts maximum boom tele speed NOTE: used when creep switch on pump pot is active | 0 to 50% | 20 | |
| | | Desired MAIN BOOM TELE IN time | | | 63-83 (see orientation) |
| | | Desired MAIN BOOM TELE OUT time | | | 58-78 (see orientation) |
| PLATFORM LEVEL: | | | | | |
| PLATFORM LEVEL | ACCEL X.Xs | Displays/adjusts basket level acceleration | 0.1 to 3.0 sec | 1.5 | |
| | DECEL X.Xs | Displays/adjusts basket level deceleration | 0.1 to 2.0 sec | 0.5 | |
| | UP MIN XX% | Displays/adjusts minimum basket level up speed. Same as Creep speed | 5 to 50% | 40 | |
| | UP MAX XXX% | Displays/adjusts maximum basket level up speed | 40 to 80% | 70 | |
| | DOWN MIN XX% | Displays/adjusts minimum basket level down speed. Same as Creep speed | 5 to 50% | 35 | |
| | DOWN MAX XXX% | Displays/adjusts maximum basket level down speed | 40 to 80% | 65 | |
| | CREEP SCALE XX% | Displays/adjusts maximum platform level speed NOTE: used when creep switch on pump pot is active | 0 to 50% | 25 | |
| PLATFORM ROTATE: | | | | | |
| PLATFORM ROTATE | ACCEL X.Xs | Displays/adjusts basket rotate acceleration | 0.1 to 3.0 sec | 1 | |
| | DECEL X.Xs | Displays/adjusts basket rotate deceleration | 0.1 to 2.0 sec | 0.5 | |
| | LEFT MIN XX% | Displays/adjusts minimum basket rotate left speed. Same as Creep speed | 5 to 50% | 25 | |
| | LEFT MAX XXX% | Displays/adjusts maximum basket rotate left speed | 30 to 60% | 36 | 24-32 (180°) |
| | RIGHT MIN XX% | Displays/adjusts minimum basket rotate right speed. Same as Creep speed | 5 to 50% | 30 | |
| | RIGHT MAX XXX% | Displays/adjusts maximum basket rotate right speed | 30 to 60% | 45 | 24-32 (180°) |
| | CREEP SCALE XX% | Displays/adjusts maximum boom tele speed NOTE: used when creep switch on pump pot is active | 50 to 100% | 90 | |
| JIB LIFT: | | | | | |
| JIB LIFT | ACCEL X.Xs | Displays/adjusts jib lift acceleration | 0.1 to 3.0 sec | 1.5 | |
| | DECEL X.Xs | Displays/adjusts jib lift deceleration | 0.1 to 2.0 sec | 1 | |
| | UP MIN XX% | Displays/adjusts minimum jib up speed. Same as Creep speed | 5 to 50% | 35 | |
| | UP MAX XXX% | Displays/adjusts maximum jib up speed | 40 to 80% | 65 | 30-36 (see orientation) |
| | DOWN MIN XX% | Displays/adjusts minimum jib down speed. Same as Creep speed | 5 to 50% | 35 | |
| | DOWN MAX XXX% | Displays/adjusts maximum jib down speed | 40 to 80% | 61 | 30-36 (see orientation) |
| | CREEP SCALE XX% | Displays/adjusts maximum jib lift up/down speed NOTE: used when creep switch on pump pot is active | 0 to 50% | 25 | |

**Table 6-4. Machine Personality Settings and Speeds**

| Submenu (Displayed on Analyzer 1st Line) | Parameter (Displayed on Analyzer 2nd Line) | Description | Range | Default Value | Times (Seconds) |
|---|---|---|---|---|---|
| JIB SWING: | | | | | |
| JIB SWING | ACCEL X.Xs | Displays/adjusts jib swing acceleration | 0.1 to 3.0 sec | 1.5 | |
| | DECEL X.Xs | Displays/adjusts jib swing deceleration | 0.1 to 2.0 sec | 0.5 | |
| | LEFT MIN XX% | Displays/adjusts minimum jib left speed. Same as Creep speed | 5 to 50% | 35 | |
| | LEFT MAX XXX% | Displays/adjusts maximum jib left speed | 30 to 60% | 48 | 42-48 (125°) |
| | RIGHT MIN XX% | Displays/adjusts minimum jib right speed. Same as Creep speed | 5 to 50% | 30 | |
| | RIGHT MAX XXX% | Displays/adjusts maximum jib right speed | 30 to 60% | 39 | 42-48 (125°) |
| | CREEP SCALE XX% | Displays/adjusts maximum jib swing speed NOTE: used when creep switch on pump pot is active | 30 to 100% | 65 | |
| GROUND MODE: | | | | | |
| GROUND | SWING SCALE XXX% | Displays/adjusts fixed swing speed | 30 to 100% | 40 | |
| GROUND BOOM | LIFT UP SCALE XXX% | Displays/adjusts fixed main lift up speed | 50 to 100% | 70 | |
| | LIFT DN SCALE XXX% | Displays/adjusts main lift down speed | 50 to 100% | 70 | |
| | MAIN TELE XXX% | Displays/adjusts fixed main telescope speed | 50 to 100% | 70 | |
| GROUND JIB | LIFT SCALE XXX% | Displays/adjusts jib lift speed Not displayed if JIB = 0 | 50 to 100% | 80 | |
| | SWING SCALE XXX% | Displays/adjusts jib swing speed Displayed if JIB = 2 | 50 to 100% | 80 | |
| GROUND PLATFORM | LEVEL SCALE XXX% | Displays/adjusts fixed basket level speed | 50 to 100% | 80 | |
| | SWING SCALE XXX% | Displays/adjusts fixed basket rotate speed | 50 to 100% | 80 | |
| ENGINE RPM: | | | | | |
| ENGINE RPM | GEN SET XXXX RPM | Control generator/welder RPM. Not displayed if GEN SET/WELDER = 0 | 900-2500 | 1800 | 1800 for 60Hz, 1900 for 50Hz |
| ALARM/HORN: | | | | | |
| ALARM/HORN: | HORN VOLUME | Displays/adjusts horn volume. | 25-100 | 100 | |
| | ALARM VOLUME | Displays/adjusts audible alarm volume. | 25-100 | 100 | |
| **TEMPERATURE CUT:** (visible if MACHINE SETUP TEMP CUTOUT = YES) | | | | | |
| LOW TEMPERATURE | CUTOUT SET: XXC | Displays/adjusts temperature for LOW TEMPERATURE CUTOUT. | -30 - 0C | -30 | |
| **PLATFORM LOAD:** (visible if MACHINE SETUP LOAD SYSTEM ≠ YES) | | | | | |
| PLATFORM OVRLD: | XXXLBS | Displays/adjusts platform overload value for full envelope capacity. | 100 - 600LBS | 600 | |
| | RESTRICT XXXXLBS | Displays/adjusts platform overload value for restricted envelope capacity. | 100 - 1000LBS | 1000 | |

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## 6.7 MACHINE ORIENTATION WHEN SETTING PERSONALITY SPEEDS

### Main Boom Lift Up

MAIN BOOM LIFT UP, from platform control, lowest elevation up to maximum elevation, main boom retracted, tower boom on rest. (AUTO/MANUAL)

### Main Boom Lift Down

MAIN BOOM LIFT DOWN, from platform control, maximum elevation down to lowest elevation, main boom retracted, tower boom on rest. (AUTO/MANUAL)

### Quick Stick Up

QUICK STICK UP, from platform control, lowest elevation up to maximum elevation, main boom fully extended, tower fully extended and at max angle, controlled arc function active.

### Quick Stick Down

QUICK STICK DOWN, from platform control, maximum elevation down to lowest elevation, main boom fully extended, tower fully extended and at max angle, controlled arc function active.

### Tower Boom Lift Up

TOWER BOOM LIFT UP, from platform control, lowest elevation up to maximum elevation, main boom retractd and horizontal.

### Tower Boom Lift Down

TOWER BOOM LIFT DOWN, from platform control, maximum elevation down to lowest elevation, main boom retractd and horizontal.

### Jib Lift Up

JIB LIFT UP, from platform control, lowest jib elevation up to maximum jib elevation, main boom retracted, tower boom retracted.

### Jib Lift Down

JIB LIFT DOWN, from platform control, maximum jib elevation down to minimum jib elevation, main boom retracted, tower boom retracted.

### Swing Right (Max)

SWING RIGHT(Max),360 Degrees, from platform control, main boom retracted, tower boom on boom rest.

### Swing Left (Max)

SWING LEFT(Max),360 Degrees, from platform control, main boom retracted, tower boom on boom rest.

### Main Boom Telescope Out

MAIN BOOM TELESCOPE OUT, from platform control, main boom horizontal, tower boom on rest, 600 lb. capacity selected, jib swing centered.

### Main Boom Telescope In

MAIN BOOM TELESCOPE IN, from platform control, main boom horizontal, tower boom on rest, 600 lb. capacity selected, jib swing centered.

### Drive Forward (Max)

DRIVE FORWARD (Max), high speed - low torque setting, drive 200 ft. front wheels to front wheels. Timed after machine has obtained maximum speed.

### Drive Reverse (Max)

DRIVE REVERSE (Max), high speed - low torque setting, drive 200 ft. front wheels to front wheels Timed after machine has obtained maximum speed.

### Drive Creep Scale (Fwd/Rev), High Torque

DRIVE CREEP SCALE (Fwd/rev), high torque - low speed setting, platform speed knob at full CCW position

### Drive Elev Max (Fwd/Rev - Boom Beyond Transport)

DRIVE ELEV MAX (Fwd/rev - Boom Beyond Transport), high speed - low torque setting, platform speed knob out of creep, raise boom above transport, drive 50 ft. Check FWD and REV. Time for faster direction must fall within target range. Slower direction may exceed target range.

## 6.8 MACHINE SENSORS AND SWITCHES

*Refer to Figure 6-40., Sensor Locations*

The JLG Control System uses multiple sensors and switches throughout the entire machine.

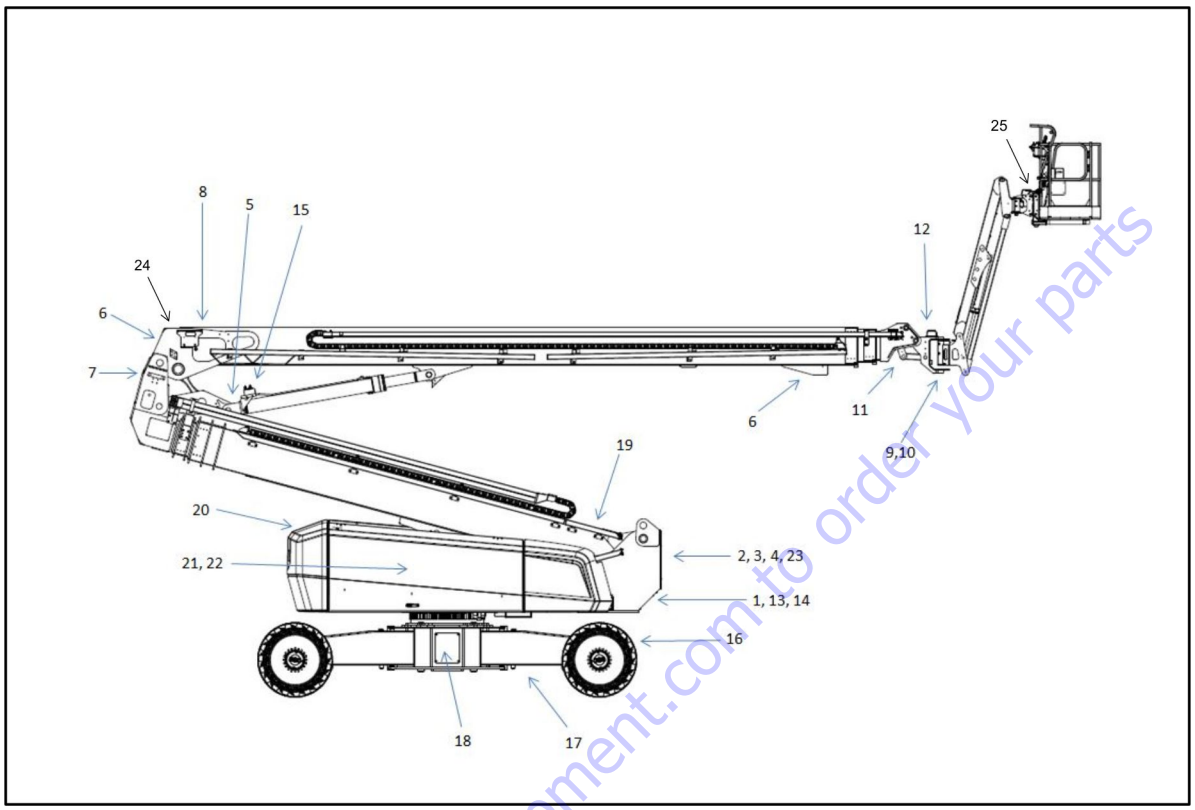



**Figure 6-40. Sensor Locations**



### Sensor #1 - Tower Lift Cylinder Angle Sensor (1)

This sensor's function is to measure tower boom angle relative to the turntable. A rotary type sensor is mounted to the Turntable and attached to the Tower Lift cylinder. It is a dual output sensor in a single mechanical body with electrically opposing signals.

#### SENSOR INSTALLATION

1. Install the sensor onto the pin.
2. Rotate the sensor clockwise until it stops.
3. Rotate the sensor counterclockwise to align the sensor holes with the holes in the sensor link.
4. Install the retaining screws.

### Sensor #2 - Tower Angle Sensors (2)

These sensors measure Tower Boom angle with respect to gravity. They are located on the bottom pivot end of the tower boom section #1 and mounted such that they generate opposing signals with respect to boom movement.

## Sensor #3 - Tower Length Sensors (2)

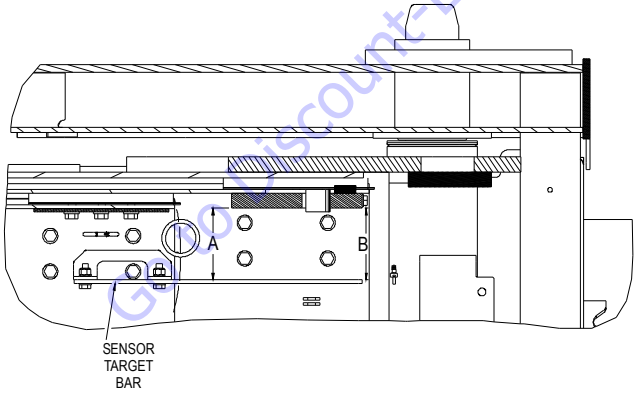
These sensors are used to measure total stroke of the tower boom. They are located in the pivot end of tower boom section #1 and consist of a wire rope attached to a rotating drum.

### TOWER BOOM PROXIMITY SWITCH AND LENGTH SENSORS INSTALLATION.

1. Shim the Sensor Target Bar using the procedure in SENSOR TARGET SHIMMING below.
2. Slide the sensor target stop against the sensor position plate before tightening the retaining bolt.
3. Adjust the proximity sensor so the sensor tip is recessed by 1 ± 0.5 mm from the track in the sensor target stop. Torque the jam nuts to 24 Nm.
4. Attach the position sensor plate to the sensor bracket leaving the bolt loose enough for later adjustment.
5. Attach the boom length sensor to the sensor bracket.
6. Attach the sensor bracket.
7. Adjust the sensor position plate on the sensor bracket so the tip of the sensor target bar is centered at the beginning of the sensor target stop. Tighten the retaining bolt. Tower boom extension is 240 mm.
8. Attach the carabiner from the boom length sensor to the ring on the fly boom. The boom can be retracted.

### SENSOR TARGET SHIMMING

1. Shim the sensor target bar so the absolute value of dimension A minus B is less than 5 mm.




2. Add washers as required to the retaining bolt between the sensor target bar and the fly boom to change the absolute value of dimension A minus B.
3. Only shim at one bolt. Do not shim at two places.

## Sensor #4 - Tower Transport Length Switch (1)

This proximity switch is used to indicate tower boom retracted position for transport. It is located in the pivot end of tower boom section #1 and is mounted so that when the boom is in the transport position it senses the presence of a target (steel bar mounted to tower boom section #3). This switch senses no target when tower boom section #3 moves beyond approximately 159mm with respect to tower boom section #1 from the fully retracted position.

## Sensor #5 - Main Boom Angle Sensor (2)

These sensors are rotary sensors mounted between the primary link and the main boom lift cylinder and are used to measure main boom angle with respect to the tower boom. These sensors are dual output sensors in a single mechanical body with electrically opposing signals (Only one channel of each sensor is used by the control system). They are mounted such that they generate opposing signals with respect to boom movement.

## Sensor #6 - Main Length Sensors (2)

These sensors are used to measure total stroke of the Main Boom. They consist of a wire rope attached to a rotating drum. A sensor is located at each end of main boom section #1.

## Sensor #7 - Main Boom Angle Switch (1)

This proximity switch is used by the Electrical Retrieval system in the event of a primary BCS system electrical failure. It is located inside of tower boom section #3 (fly nose) and senses a cam (target) on main boom section #1. This switch senses no target when the main boom angle is greater than approximately 24° relative to the Tower Boom.

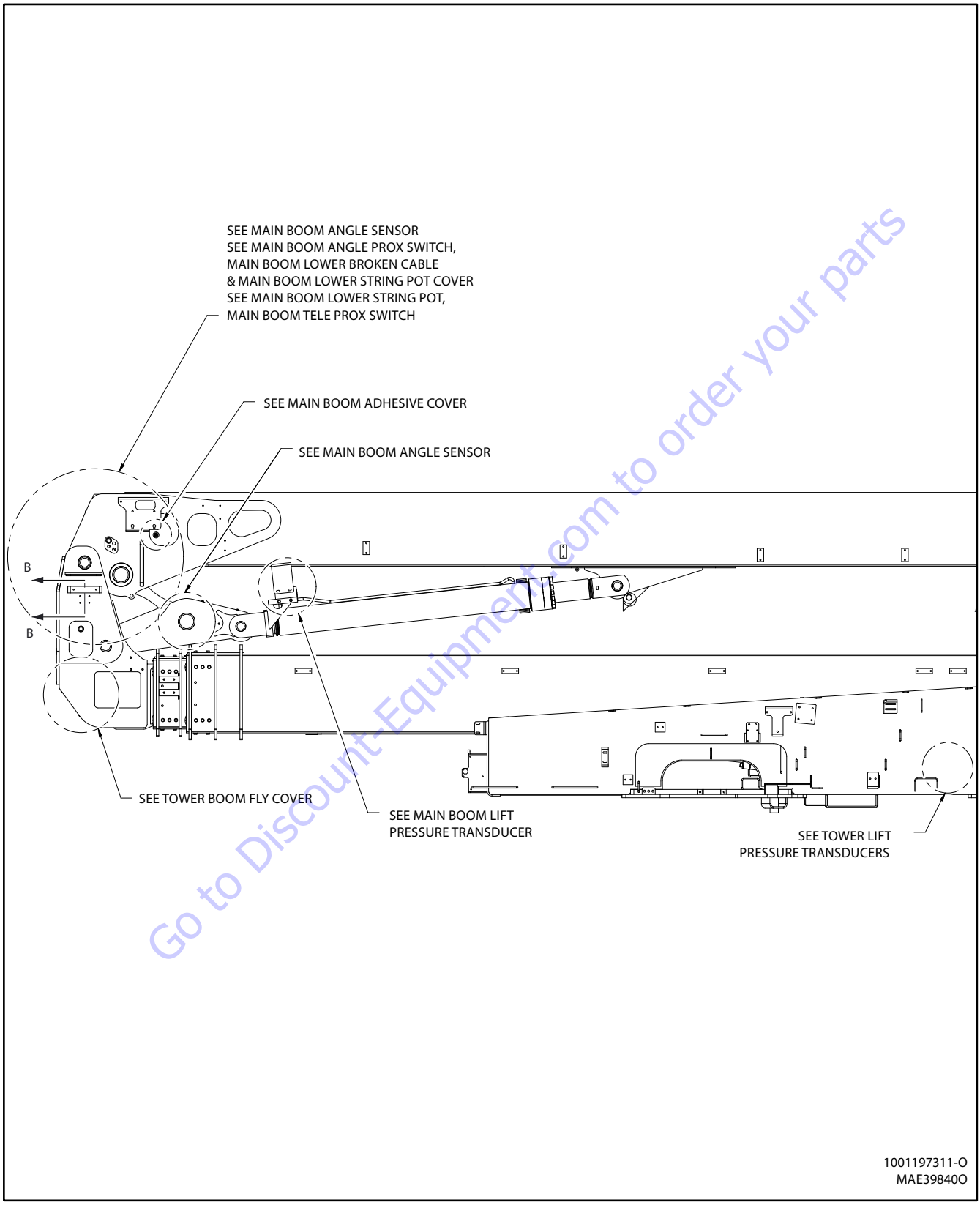





**Figure 6-41. Boom Sensors Installation - Sheet 1 of 13**

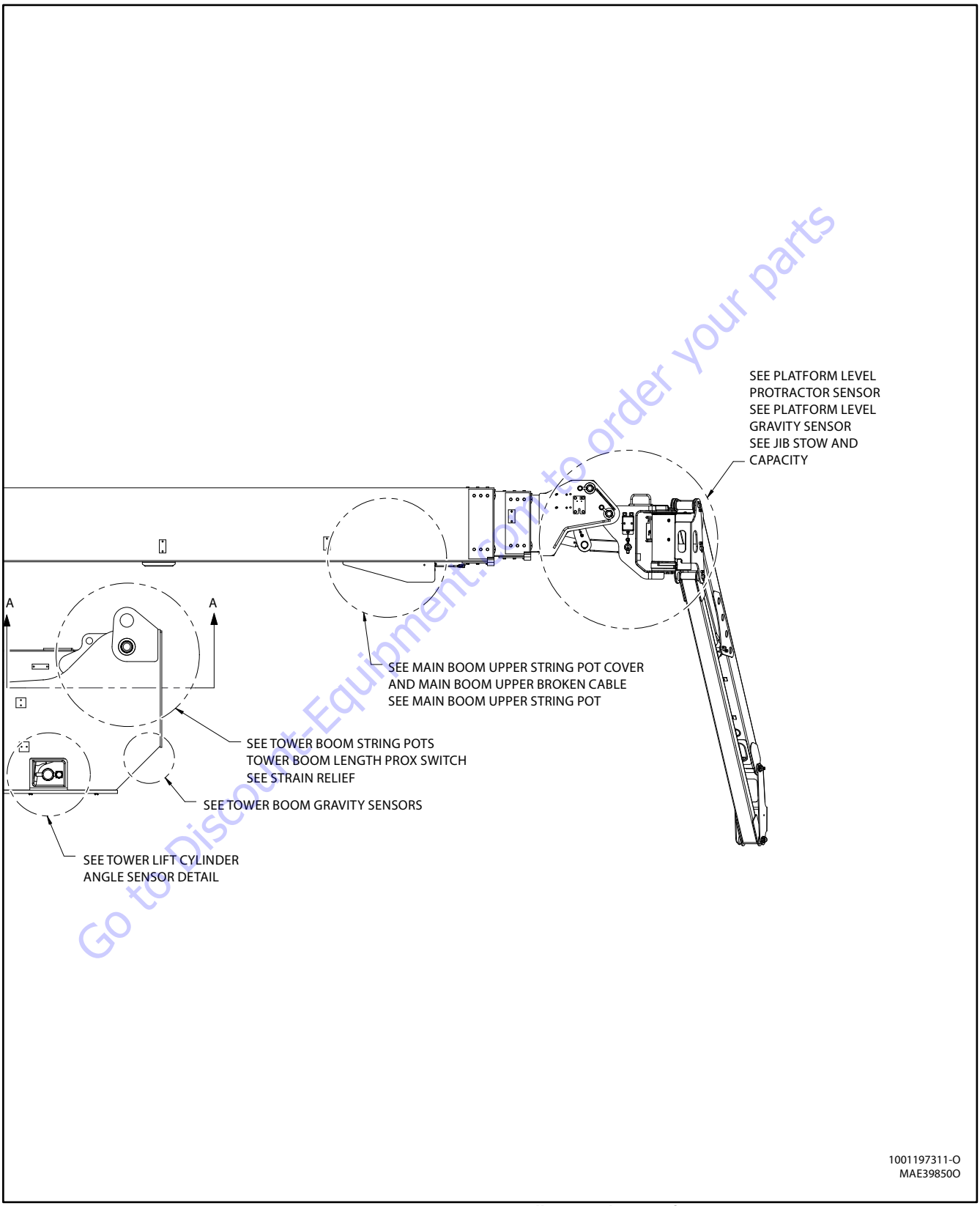





**Figure 6-42. Boom Sensors Installation - Sheet 2 of 13**

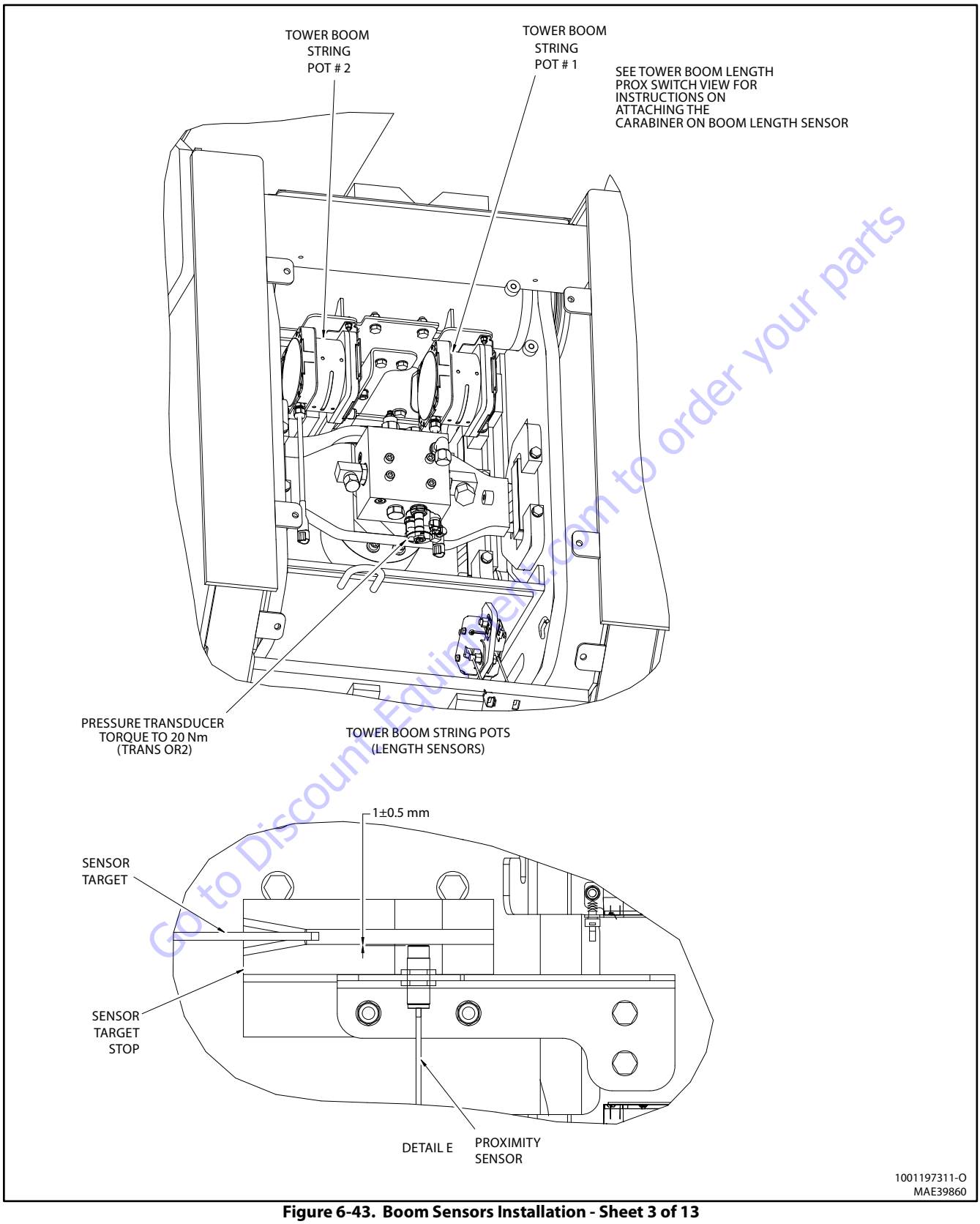





**Figure 6-43. Boom Sensors Installation - Sheet 3 of 13**

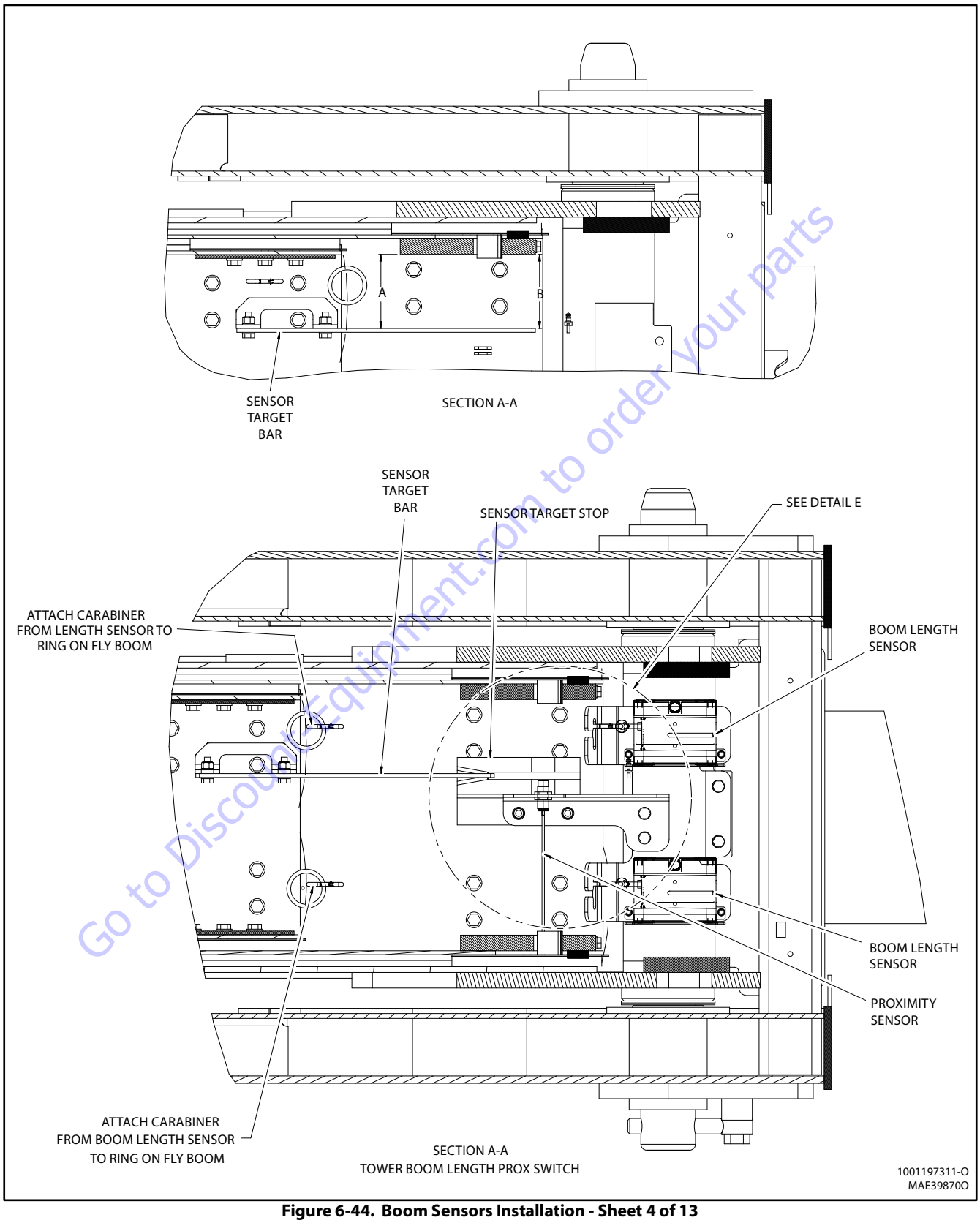





**Figure 6-44. Boom Sensors Installation - Sheet 4 of 13**

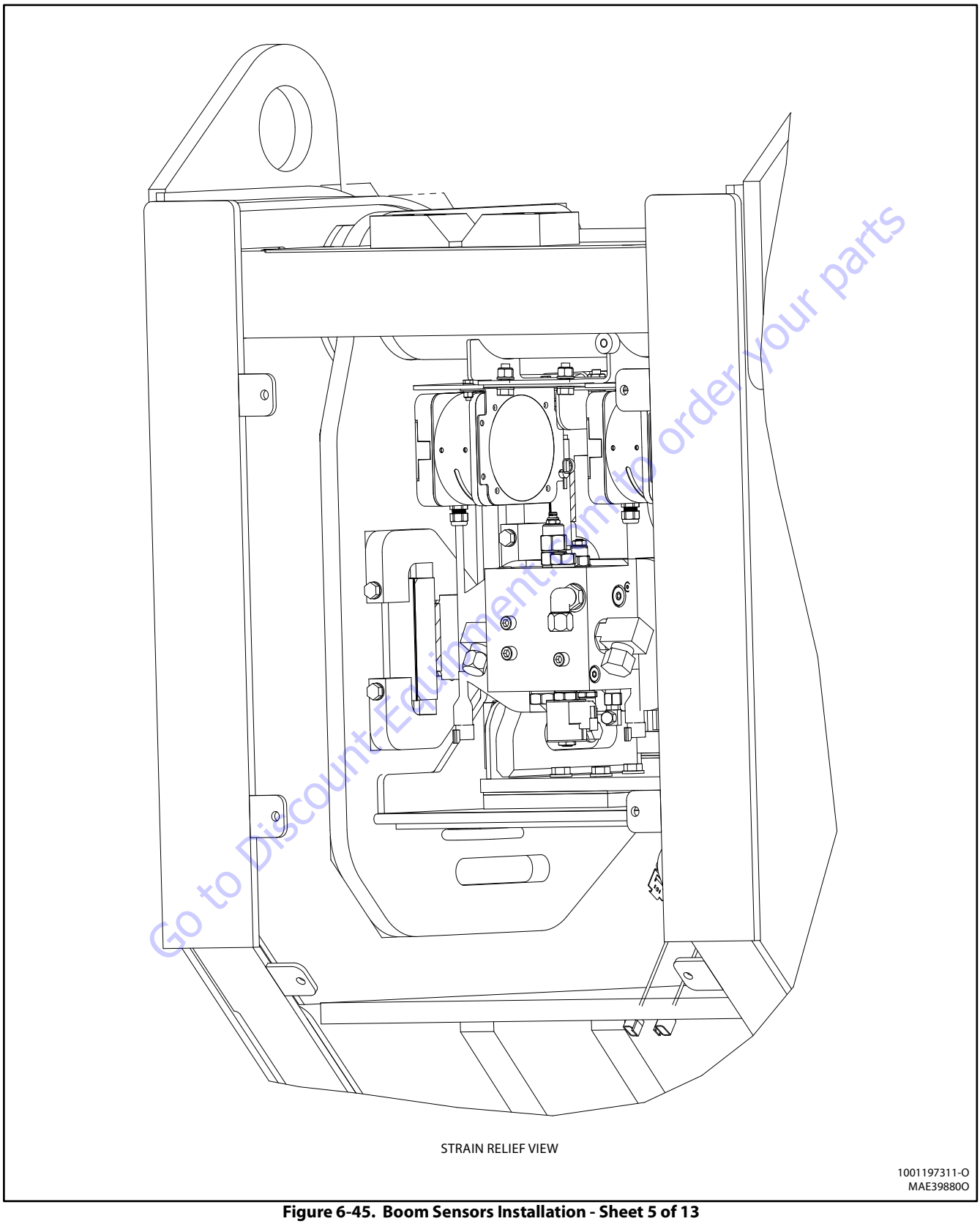
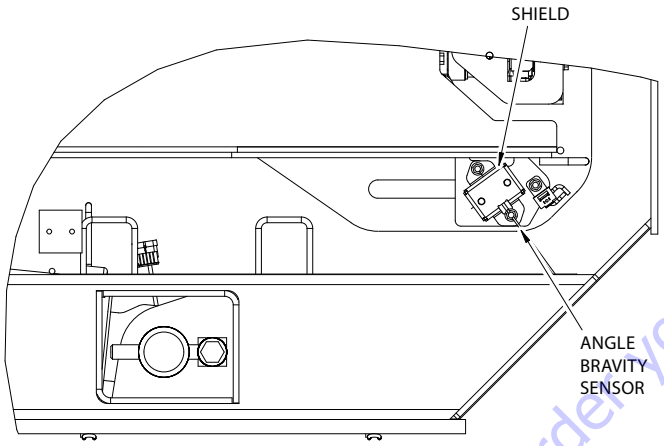


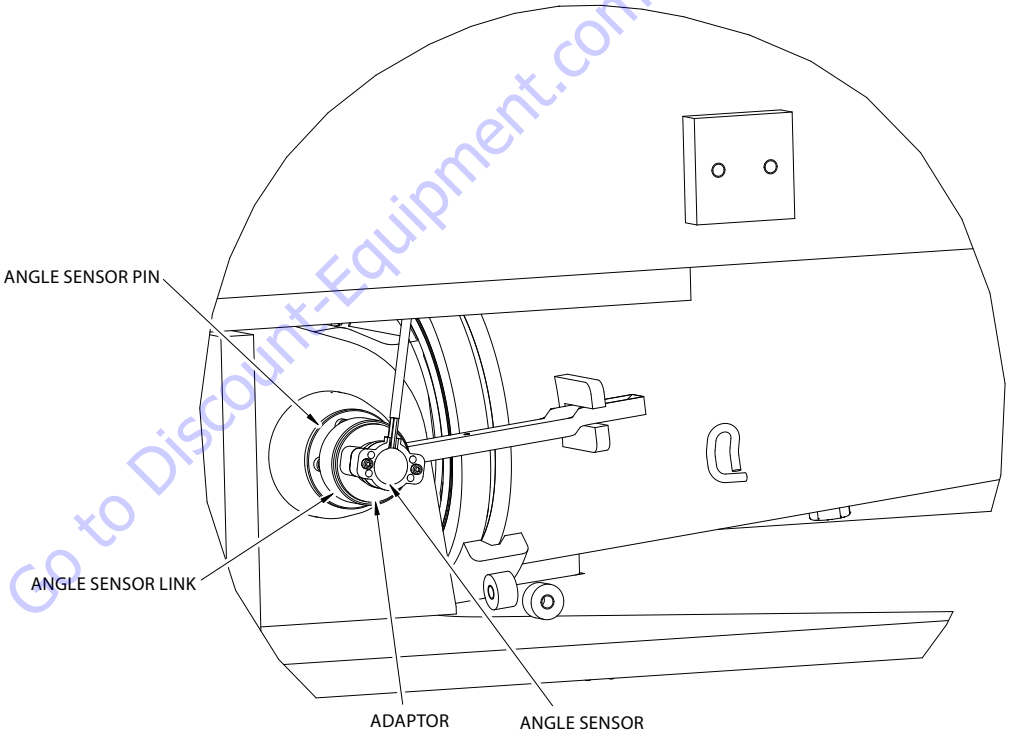



**Figure 6-45. Boom Sensors Installation - Sheet 5 of 13**

TOWER BOOM GRAVITY SENSOR # 1 IS ON THE RIGHT SIDE OF THE MACHINE VIEWED FROM THE PLATFORM
TOWER BOOM GRAVITY SENSOR # 2 IS ON THE LEFT SIDE OF THE MACHINE VIEWED FROM THE PLATFORM




TOWER BOOM GRAVITY SENSOR




TOWER LIFT CYLINDER
ANGLE SENSOR DETAIL

1001197311-O
MAE39890O



**Figure 6-46. Boom Sensors Installation - Sheet 6 of 13**

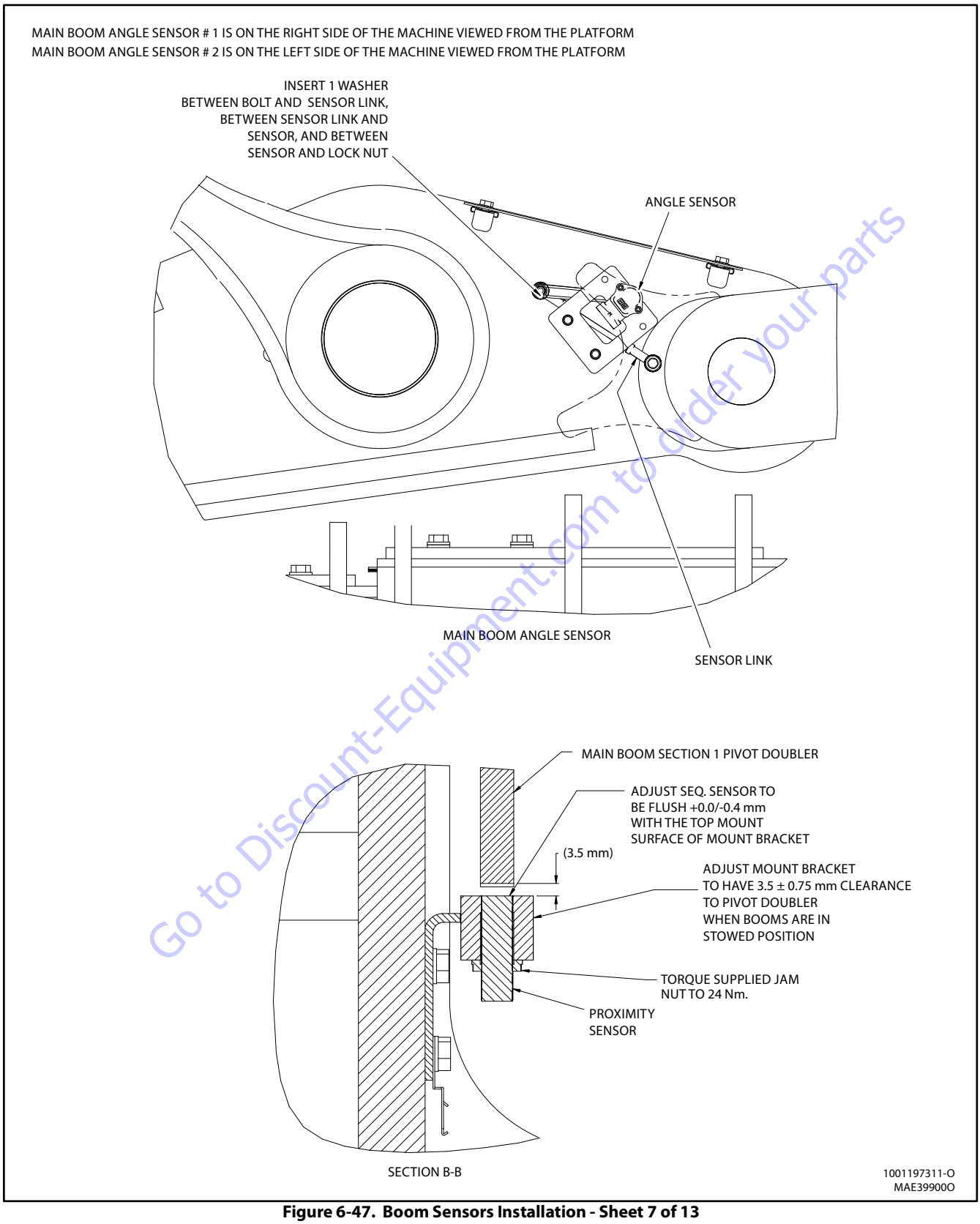





**Figure 6-47. Boom Sensors Installation - Sheet 7 of 13**

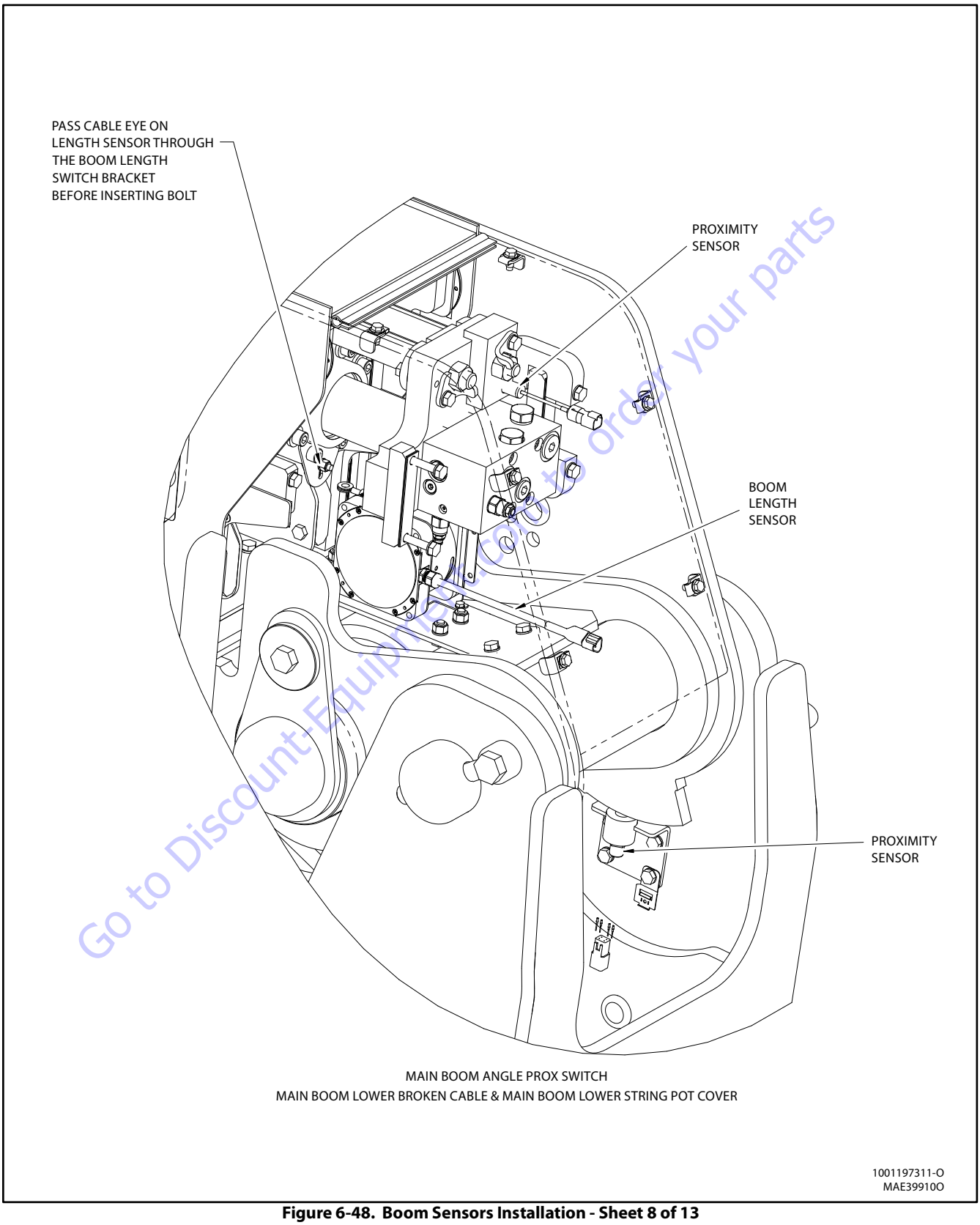





**Figure 6-48. Boom Sensors Installation - Sheet 8 of 13**

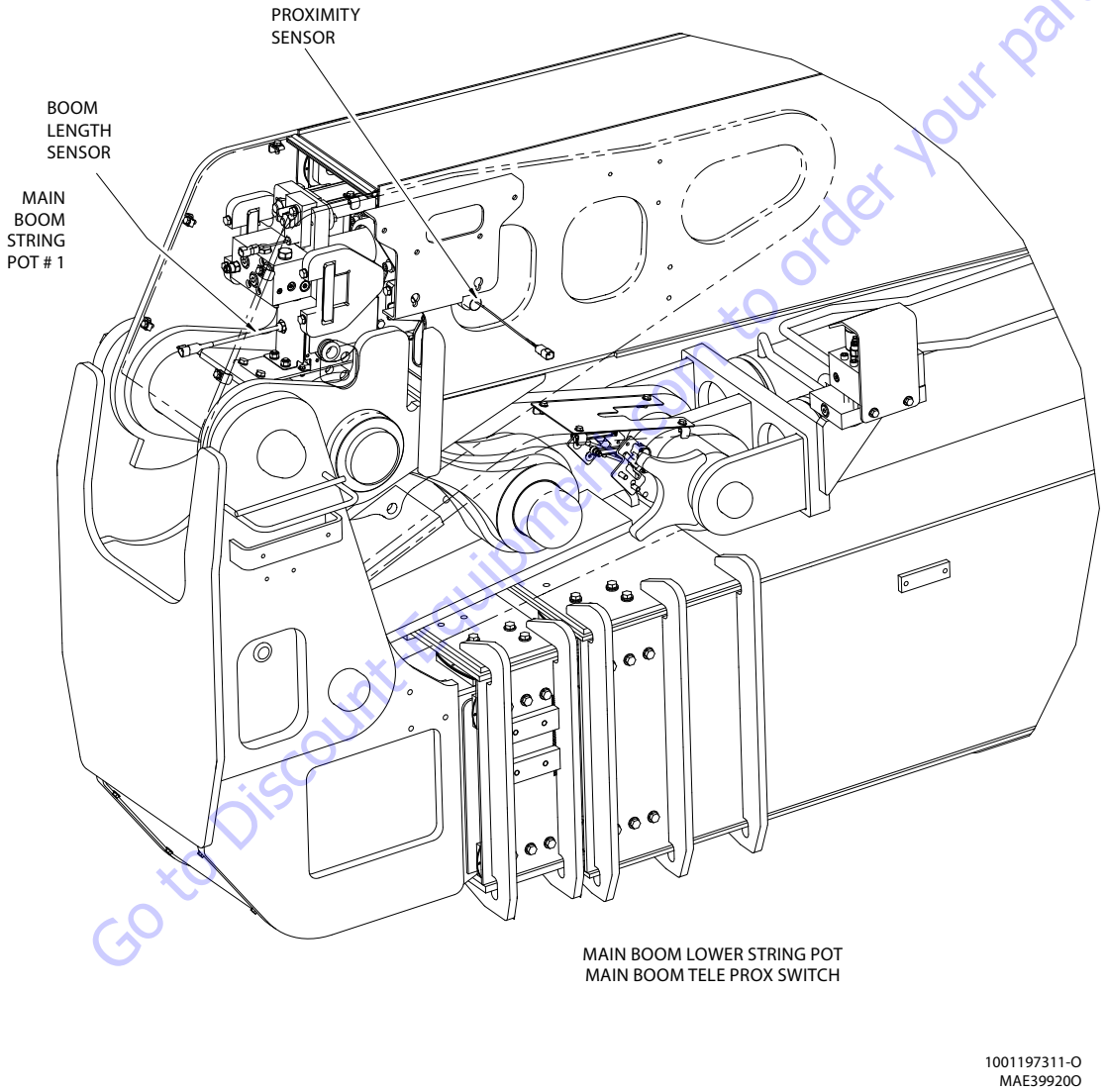





**Figure 6-49. Boom Sensors Installation - Sheet 9 of 13**

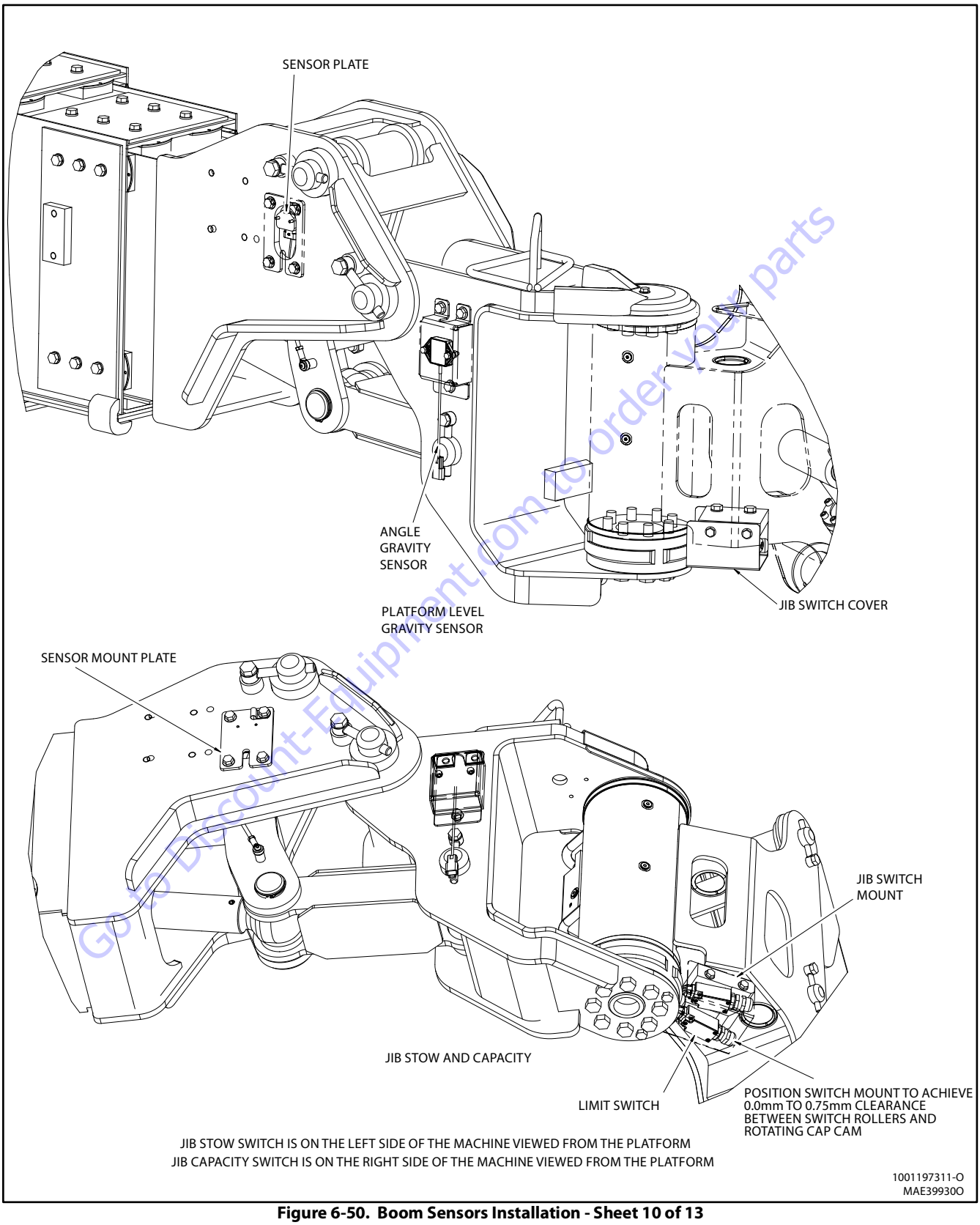





**Figure 6-50. Boom Sensors Installation - Sheet 10 of 13**

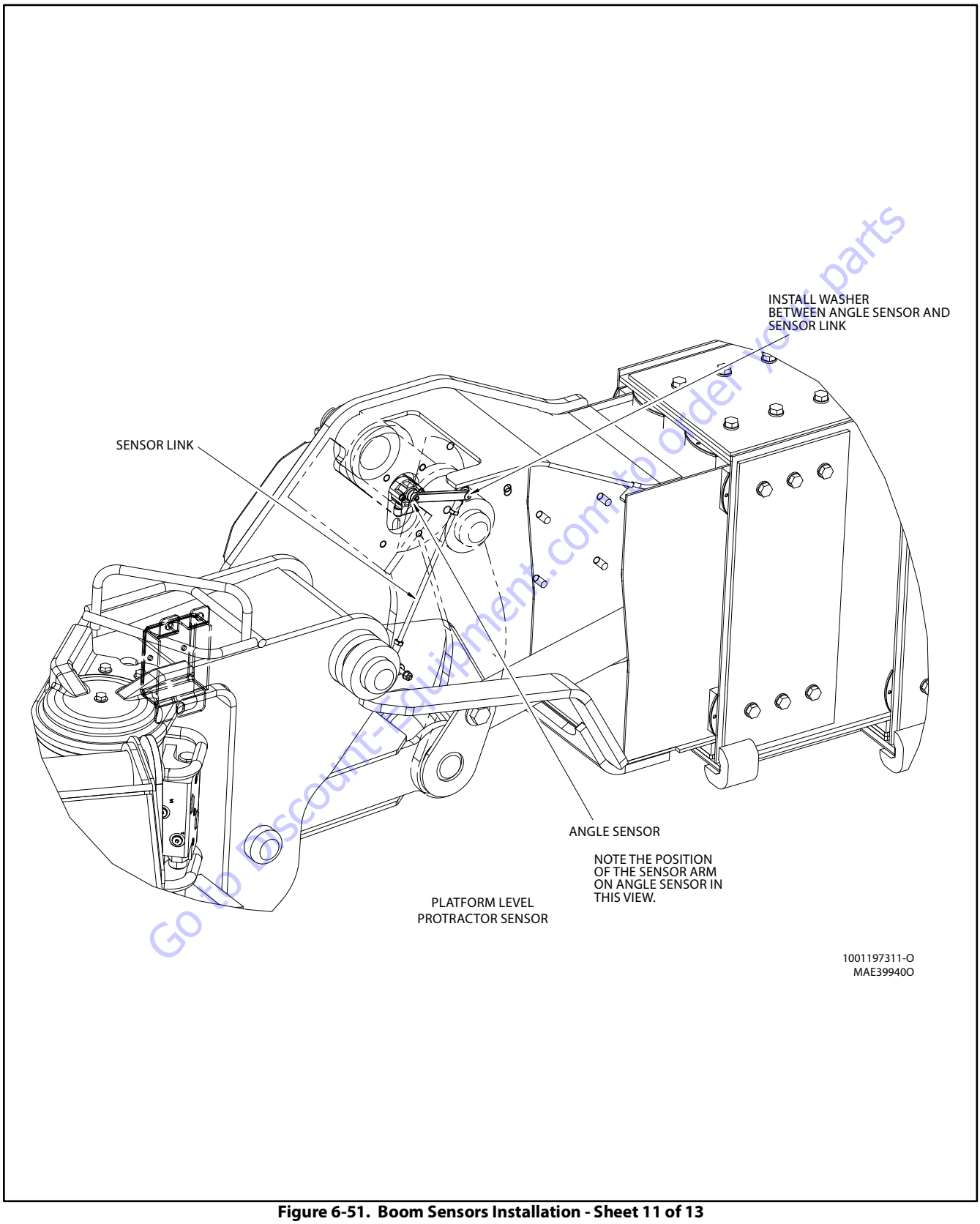





**Figure 6-51. Boom Sensors Installation - Sheet 11 of 13**

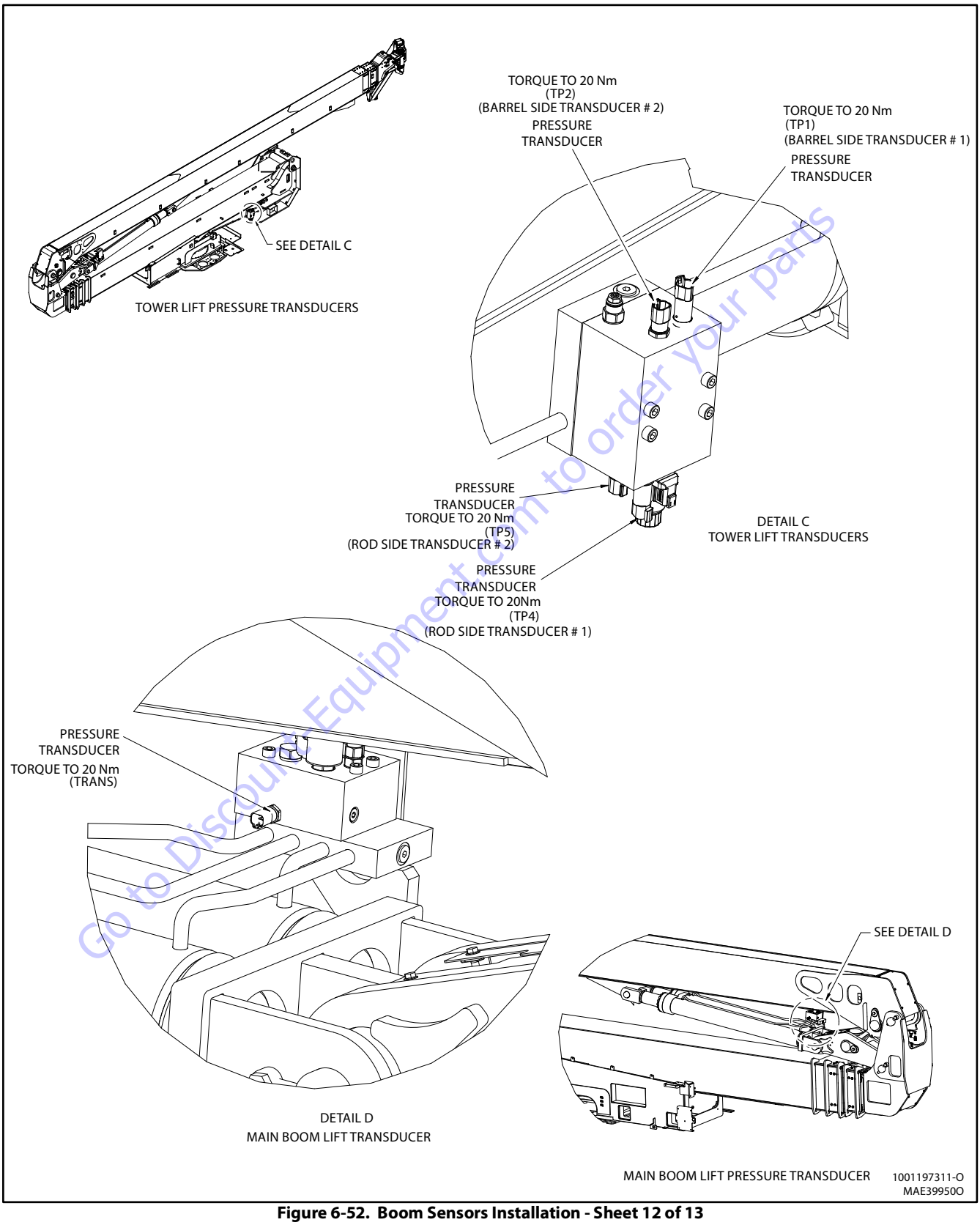





**Figure 6-52. Boom Sensors Installation - Sheet 12 of 13**

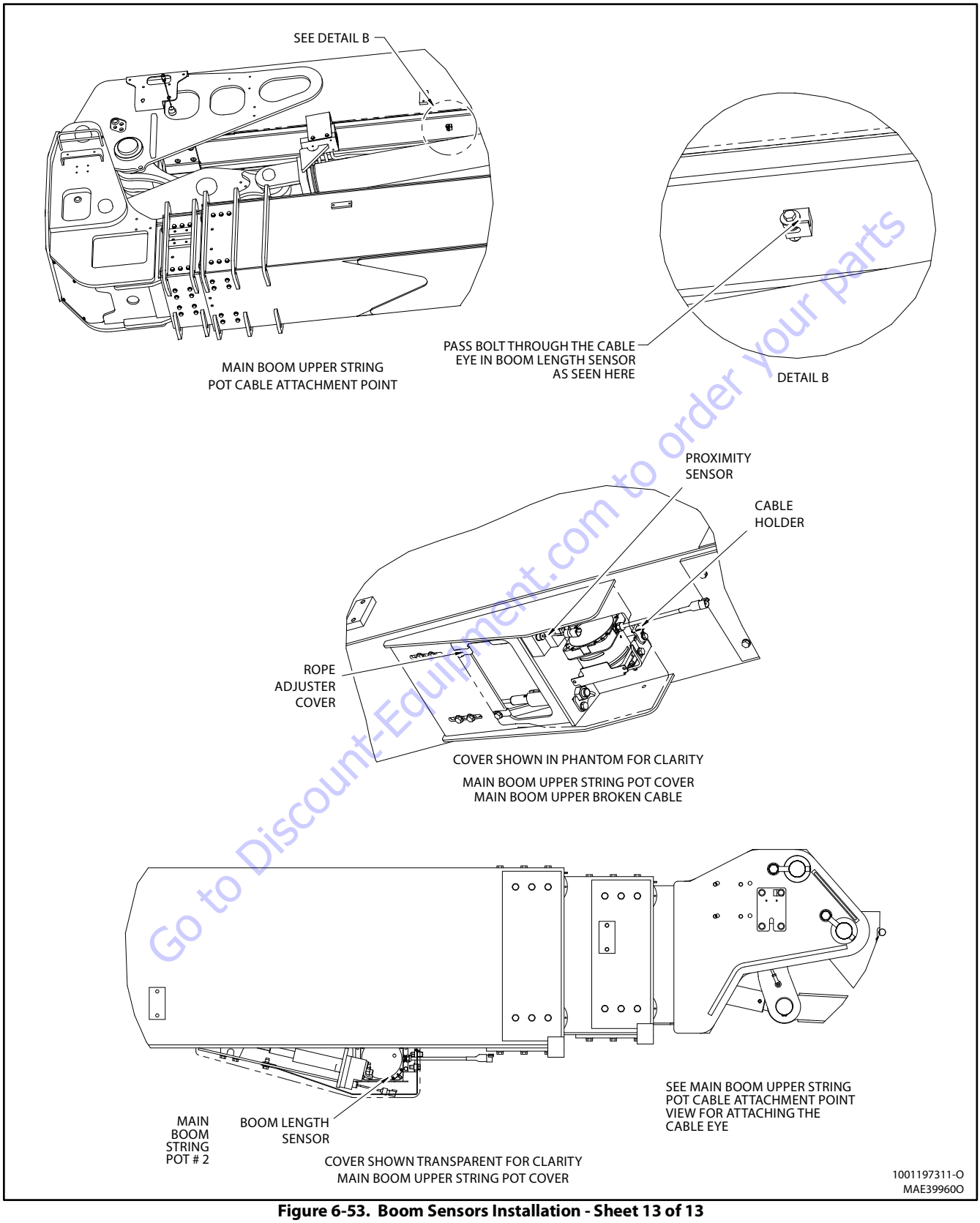





**Figure 6-53. Boom Sensors Installation - Sheet 13 of 13**

## 6.9 BOOM SENSOR POSITIONS/FUNCTIONS

**Table 6-5. Boom Sensor Positions/Functions**

| Sensor Position/Function | Sensing Method | Raw Output |
|---|---|---|
| Tower Boom Angle Sensors (2) - These sensors measure Tower Boom angle with respect to gravity and generate electrically opposing signals | Gravity Based PWM Output (100Hz) | 5 - 95% duty cycle |
| Tower Boom Length Sensors (2) - These sensors measure the length of the Tower Boom by measuring the stroke of the fly relative to the base booms. The intent is to mount these sensors with opposite signals. | 5 kΩ Potentiometer Voltage Output | 0.05 - 4.75 Volts |
| Tower Boom Cylinder Angle Sensor (2) - These sensors measure the Tower Boom angle relative to the Turntable. They are integrated into the same mechanical body with the dual output generating electrically opposing signals | 5V protractor hall effect PWM Output (100Hz) | 10 - 90% duty cycle<br>90 - 10% duty cycle |
| Tower Boom Transport Length Switch (2) - This proximity switch is used to indicate the Tower Boom retracted position. This switch mounted to the pivot end of the base boom detecting the presence of fly when in the retracted state. | Dual Output Proximity Switch | Normally Open<br>Normally Closed |
| Main Boom Angle Sensors (2) - These sensors measure Main Boom angle with relative to the Tower Boom and generate electrically opposing signals. | 5V protractor hall effect PWM Output (100Hz) | 5 - 95% duty cycle |
| Main Boom Angle Switch (2) – This proximity switch will indicate the main boom angle below a TBD angle relative to the Tower Boom | Proximity Switch | Normally Open<br>Normally Closed |
| Main Boom length sensors (2) - These sensors measure the length of the Main Boom by measuring the stroke of base relative to mid booms. The intent is to mount these sensors with opposite signals. | 5 kΩ Potentiometer Voltage Output | 0.05 - 4.75 Volts |
| Main Boom Transport Length Switch (2) - This proximity switch is used to indicate the Main Boom retracted position. The trip length is TBD". | Proximity Switch | Normally Open<br>Normally Closed |
| Platform Level Angle Sensors (2) - The gravity sensor is located on the Platform/Jib Support and is used to measure platform angle with respect to gravity and providing redundancy check for the protractor. The protractor is used for velocity control of platform level (and possibly for platform leveling of retrieval modes) | Gravity Based PWM Output (100Hz)<br>5V protractor hall effect PWM Output (100Hz) | 5 - 95% duty cycle<br>5 - 95% duty cycle |
| Steer Angle Sensors (4) - These sensors are used to measure wheel steer angles. These rotary sensors are mounted on top of each king pin | 5V hall effect sensor Analog Output | 0.5 - 4.5 Volts |
| Axle extend/retract Sensors (4) - These sensors are used to measure axle rotation between the retracted and extended positions. Each sensor is mounted between the frame and an axle | Linear Resistive 5V Analog Output | 0.1 - 4.9 Volts |
| Brake/2 Speed Pressure Check (1) - This pressure sensor monitors that there is no pressure present when the associated valves are not activated | 5V Pressure switch | Normally Open |
| Chassis Tilt Sensors (Externally mounted) (1) – These sensors are the primary tilt sensors and measure the tilted angle of the turntable relative to gravity. They are integrated into the same mechanical body | Gravity Based CANbus Output | CAN Msg |
| Internal UGM Tilt Sensor(2) - used for redundancy check against the external tilt sensor | Analog | |
| Warm Up Switch (1) – This switch monitors the temperature of the main control valve. This is used the same as the 1250AJP | Bi-metallic strip, low-side input switch | Normally Open |

**Table 6-5. Boom Sensor Positions/Functions**

| Sensor Position/Function | Sensing Method | Raw Output |
|---|---|---|
| Pressure Reduction Check – (1) - It is used to monitor pressure of the lower pressure functions of the machine ), to assure that they are within the regulated range. Pressure range 0-7500PSI | 5V analog | 0.5 - 4.5 Volts |
| Tower Lift Cylinder (rod side) Pressure Transducer (2) - These pressure transducers are located on the port block of the Tower boom lift cylinder. These are used for the diagnostics (cut piston seal) of the lift cylinder and used in the calculation for determining lift cylinder force for the retrieval system. Pressure range 0-7500PSI | 5V analog | 0.5 - 4.5 Volts |
| | | 0.5 - 4.5 Volts |
| Main Lift Cylinder (rod-side) Pressure Transducer (1) - This pressure transducer is located on the port block of the Main boom lift cylinder. This is used for the diagnostics of the lift cylinder. Pressure range 0-7500PSI. | 5V analog | 0.5 - 4.5 Volts |
| Main boom Broken Cable prox switch (2). One to detect broken extend ropes. One to detect broken retract ropes | Proximity Switch | Normally Open |
| Tower Tele Cylinder Pressure Transducer (1) - This pressure transducer is located on the port block of the Tower boom tele cylinder. This is used for the diagnostics of the tele cylinder. Pressure range 0-7500PSI. | 5V analog | 0.5 - 4.5 Volts |
| Jib in line limit switch (2) - Used like the 1250AJP, dual capacity mode. Both Signal lines are wired for redundancy check. | Plunger Switch | Normally Closed |
| | | Normally Open |
| Jib stow limit switch (1) Used like the 1250AJP | Plunger Switch | Normally Closed |
| Drive Orientation Sensing Prox switch. This is integrated in the hydraulic swivel/collector ring. Same as 1250AJP. | Non contact proximity switch | Inline: Closed |
| Tower Lift Cylinder (Barrel side) Pressure Transducer (2) - These pressure transducers are located on the port block of the Tower boom lift cylinder. These are used in the calculation for determining lift cylinder force for the retrieval system. Pressure range 0-7500PSI | 5V analog | 0.5 - 4.5 Volts |
| | | 0.5 - 4.5 Volts |
| Platform Dump Valve Pressure Switch | Pressure Switch | Normally Open |

## Sensor #8 - Main Boom Transport Length Switch (1)

This proximity switch is used to indicate main boom retracted position for transport. It is located in the left rear of main boom section #1and is mounted so that when the boom is in the transport position it senses the presence of a target (main boom section #2). This switch senses no target when the main boom has extended beyond approximately 370mm (cylinder stroke of approximately 185mm) from the fully stowed position. This switch provides a normally open output and a normally closed output.

**TRANSPORT LENGTH SWITCH INSTALLATION**

1. Remove the jam nuts from the switch.
2. Thread the proximity sensor into the main base boom until it softly bottoms out on the main mid boom.
3. Turn the proximity switch out $4 \pm 0.25$ turns.
4. Torque the jam nut to 38 Nm.

## Sensor #9 - Jib Stow Switch (1)

This switch is used by the Jib Stow system and is located on the rotary assembly. It is a mechanical limit switch.

## Sensor #10 - Dual Capacity Jib Position Switch (1)

This switch is used by the Dual Capacity system and is located on the rotary assembly. It is a mechanical limit switch.

## Sensor #11 - Platform Level Protractor Sensor (1)

This is a rotary sensor and is used by the Electronic Platform Level system. It measures platform angle relative to the main boom and is used primarily for velocity control of platform leveling. It is a rotary sensor mounted on the platform end of main boom section #3.

## Sensor #12 - Platform Level Angle Gravity Sensor (1)

This sensor is located on the jib pivot weldment and is used to measure platform angle with respect to gravity. This sensor is used for positional control of platform leveling.

## Sensor #13 - Barrel End Pressure Transducer (Tower Boom Lift cylinder) (2)

These transducers are used in conjunction with the rod end pressure transducers to derive forces on the tower boom lift cylinder for the electrical retrieval system and are located on the tower boom lift cylinder port block.

## Sensor #14 - Rod End Pressure Transducer (Tower Boom Lift Cylinder) (2)

These transducers are used in conjunction with the barrel end pressure transducers to derive forces on the tower boom lift cylinder for the electrical retrieval system. These sensors will also be used for tower boom control and for cylinder diagnostics. These sensors are located on the tower boom lift cylinder port block.

## Sensor #15 - Rod End Pressure Transducer (Main Boom Lift Cylinder) (1)

This transducer is used for main lift cylinder diagnostics. It is located in the main lift cylinder port block.

## Sensor #16 - Steer Angle Sensor (4)

These sensors are used to measure wheel steer angles. These rotary sensors are mounted on top of each king pin.

## Sensor #17 - Axle extend/retract Sensor (4)

These sensors are used to measure axle rotation between the retracted and extended positions. Each sensor is mounted between the frame and an axle.

## Sensor #18 - Brake-Two Speed Pressure Sensor (1)

This pressure switch monitors that there is no pressure present when the associated valves are not activated.(Review terminology)

## Sensor #19 - Chassis Tilt Sensor (Externally mounted) (1)

This sensor is the primary tilt sensor and measures the tilted angle of the turntable relative to gravity. It is mounted on a bracket on the right side of the turntable above the batteries. It is a dual axis output sensor in a single body.

## Sensor #20 - Tilt Sensor (2)

These sensors are integral to the UGM. These sensors are secondary tilt sensors and measure the tilted angle of the chassis relative to gravity. They are used to check plausibility of the primary chassis tilt sensor reading (See Sensor #19).

## Sensor #21 - Warm up Switch (1)

This switch is located on return oil manifold located beside the main control valve and is used by the Hydraulic System Warm Up.

## Sensor #22 - Main Valve Pressure Transducer (1)

This pressure transducer is located on the main control valve. It is used to monitor pressure of the lower pressure functions of the machine (all control valve functions except main lift, tower lift and tower telescope), to assure that they are within the regulated range.

## Sensor #23 - Tower Tele Cylinder rod side Pressure Transducer (1)

This pressure transducer is located on the port block of the tower boom tower tele cylinder. This transducer is used for diagnostics and improved flow control.

## Sensor #24 - Broken Wire Rope Service Indicator Sensor

The Broken Wire Rope Indicator System shows the operator one of the ropes has failed or needs adjustment. This system uses two proximity sensors (One for extend ropes and one for retract ropes) to detect excessive movement of the sensed rope as would be expected with a rope failure. A broken rope detection results in illuminating the Cable Break indicator on the platform control panel.

### INSTALLATION

1. To avoid damage to the sensor, install and adjust after assembling the switch block, compression spring, and tensioning the wire ropes.
2. Remove the jam nuts from the proximity sensor.
3. Thread the sensor in till it makes contacts the adjuster block.
4. Turn the proximity sensor out 1/8 to 1/2 turn.
5. Torque the jam nut against the housing to 24 Nm.

## Sensor #25 - Platform Dump Valve Pressure Switch

This pressure switch is located on the platform port block. Under regular operation, the platform dump valve will close when an operator function is demanded. The control system uses this pressure switch to detect a malfunctioning platform dump valve

# 6.10 CALIBRATION PROCEDURES

This machine incorporates a variety of sensors and a high degree of function interaction. For safety and proper machine functionality, the calibration procedures must be repeated for any control module replacement, system calibration related fault, or removal or replacement of any sensors, valves, coils, motors, or pumps. The chart below lists the calibrations required and potential reasons for re-calibration. All calibration procedures are menu driven through the use of the standard analyzer. With the exception of steering calibration, no external tools are required to complete the calibration procedures. The user is prompted to exercise the machine in a specific order to use the machines physical properties to consistently establish sensor response and the interaction of valves, pumps, and motors. Steering calibration also uses the analyzer and is performed on one side of the machine at a time requiring the use of a string or other means to determine when the tires are in line with each other. All calibrations are accessed by connecting the analyzer into the control system at the appropriate location.

At various steps during calibration if a sensor is not meeting the required range the operator is allotted a retry attempt before failure of the calibration procedure.

**Table 6-6. Required Calibrations**

| Calibration Procedure | Reasons for Re-Calibration |
|---|---|
| Steering Calibration | Ground module replacement<br>Chassis module replacement<br>Steer sensor removal or replacement<br>Persistent wheel misalignment |
| Drive Calibration | Ground module replacement<br>BLAM module replacement<br>Drive pump/coil replacement<br>Drive pulls to one side<br>Drive lugs engine<br>Poor slow speed control |
| Main Boom Lift Up and down Flow Control Calibration | Ground module replacement<br>Lift proportional valve/coil replacement<br>Erratic controlled arc operation<br>Erratic controlled boom angle operation<br>Pressure transducer replacement for lift down |
| Main Boom Lift Down Enable | Ground module replacement<br>Main lift proportional valve replacement<br>Erratic controlled arc operation<br>Erratic controlled boom angle operation |
| Main boom Lift Down Auxiliary Enable | Ground module replacement<br>Main lift proportional valve replacement<br>Erratic controlled arc operation<br>Erratic controlled boom angle operation |
| Boom Telescope In and Out Flow Control | Ground module replacement<br>Telescope proportional valve replacement<br>Erratic controlled arc operation<br>Erratic controlled boom angle operation |

**Table 6-6. Required Calibrations**

| Calibration Procedure | Reasons for Re-Calibration |
|---|---|
| Tower Lift Up and Down Flow Control | Ground module replacement<br>Telescope or lift proportional valve replacement<br>Erratic tower path operation<br>Pressure transducer replacement for tower down<br>Tower consistently encroaches envelope |
| Tower Lift Down Enable | Ground module replacement<br>Telescope or lift proportional valve replacement<br>Erratic tower path operation<br>Tower consistently encroaches envelope |
| Tower Telescope In and Out Flow control | Ground module replacement<br>Telescope or lift proportional valve replacement<br>Erratic tower path operation<br>Pressure transducer replacement for tele in<br>Tower consistently encroaches envelope |
| Tower Telescope In Enable | Ground module replacement<br>Telescope or lift proportional valve replacement<br>Erratic tower path operation<br>Tower consistently encroaches envelope |
| Chassis Tilt Calibration | Ground module removal or replacement<br>Constant disagreement faults<br>Tilt indication inaccuracy<br>External tilt sensor removal or replacement |
| Boom Sensors Calibration | Ground module removal or replacement<br>BLAM module removal or replacement<br>Tower and Main Boom angle sensor removal or replacement<br>Tower and Main Boom length sensor removal or replacement<br>Tower and Main Boom angle sensor calibration fault<br>Tower and Main Boom length sensor calibration fault<br>Boom control system inaccuracies<br>Platform level sensor replacement<br>Prox switch replacement |
| Platform Load Sensing Calibration | Load cell removal or replacement<br>Load control inaccuracy |
| Axle Extend/Retract Sensors Calibration | Ground module replacement<br>Axle extend/retract sensor removal or replacement<br>Axle extend out of range fault |
| Platform level proportional valve | Ground module replacement<br>Level up and/or down coil/valve replacement<br>Persistent leveling timeout |

## 6.11 AXLE CALIBRATION

The axle angle sensors need to be calibrated to ensure that the axle angle can be accurately calculated. The machine must be in transport position to perform an axle calibration. If the steer sensors have not been calibrated, they will be calibrated as part of the axle calibration procedure.

Axle Calibration is available under AXLE SWING under the CALIBRATIONS menu using the analyzer.

When performing a calibration, the first prompt will be to RETRACT AXLES.

The analyzer will prompt to move to the next sequence once the axle retract conditions are met and retract values are stored in the Control System.

If the steer sensors have not been calibrated when an axle calibration is attempted, the system shall require the steer sensors be calibrated. If this is the case, the analyzer prompt shall automatically redirect to the steer sensor calibration section after the axle retract position is calibrated (Refer to steer sensor calibration). If the steer sensors have been calibrated, this step shall be skipped.

The analyzer will prompt to EXTEND AXLES.

The analyzer shall prompt to move after the extend conditions are met and extend values are stored in the Control System. The axle calibration is complete at this point.

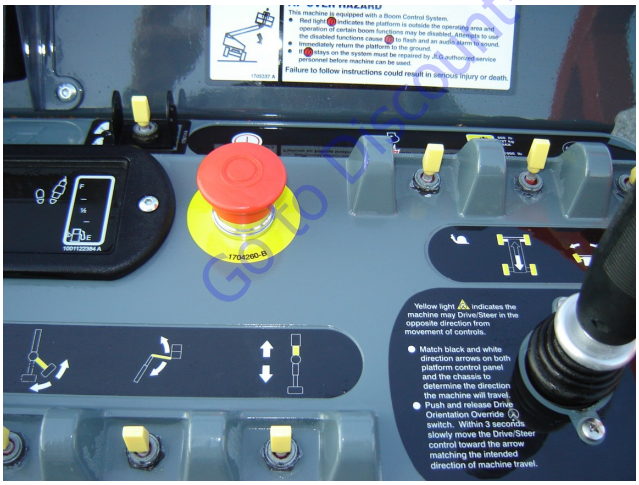
## 6.12 CALIBRATING STEER

***NOTE:*** *The Steer menu will not appear on the analyzer until the axles are fully retracted.*

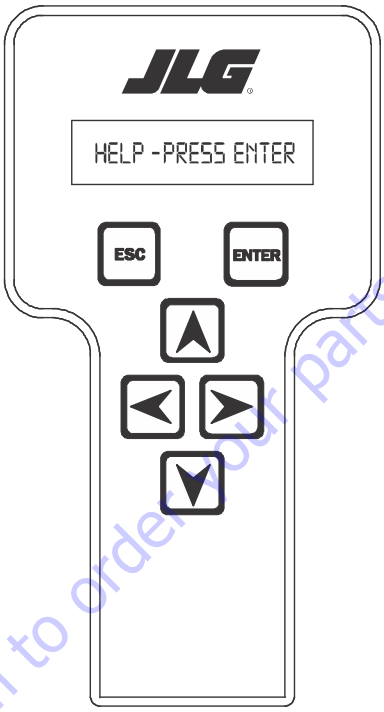
When calibrating steering, each individual wheel must be calibrated in order to make the tire and wheel parallel with the frame. Two methods to help ensure proper calibration are the use of a carpenter's square to square the spindle to the axle or aligning the two wheels on one side using a stretched string.

1. Position the Platform/Ground select switch to the Platform position.
2. Plug the analyzer into the connector at the base of the platform control box.


3. Pull out the Emergency Stop switch and Start the engine.

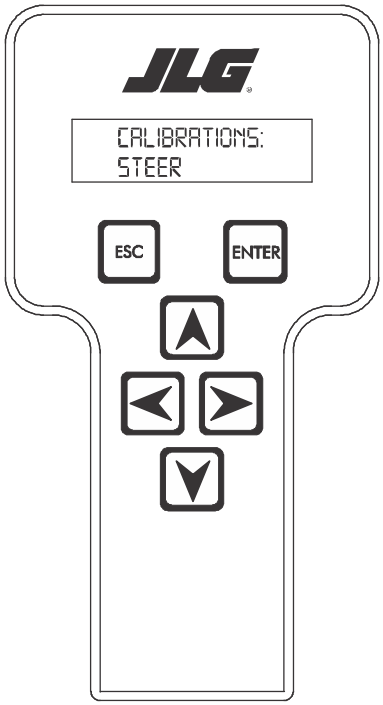


4. The analyzer screen should read:

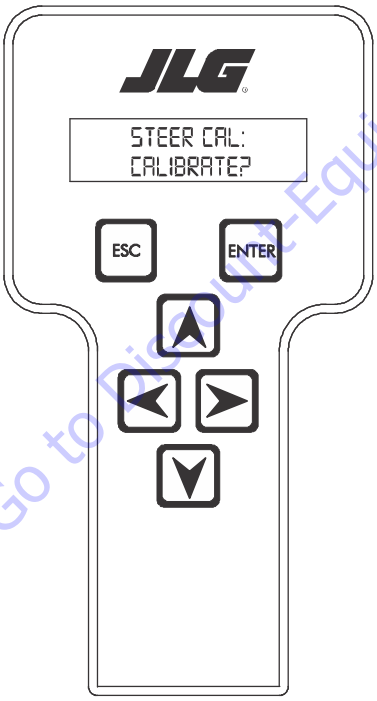



5. Use the arrow button to reach OPERATOR ACCESS. Press Enter.
6. Enter the Access Code, 33271.
7. Use the right Arrow key to reach CALIBRATIONS. Press Enter.

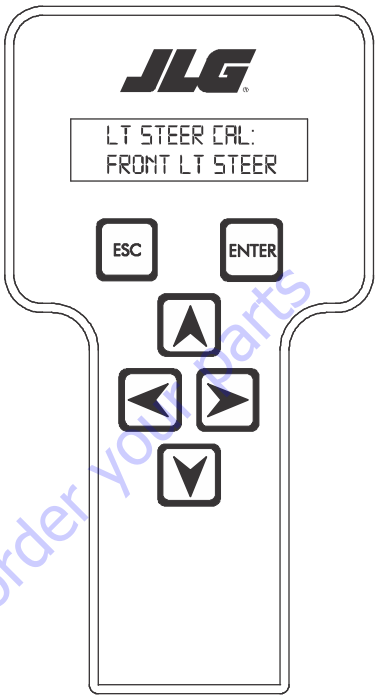
**8.** Use the arrow keys to reach Steer. The screen will read:



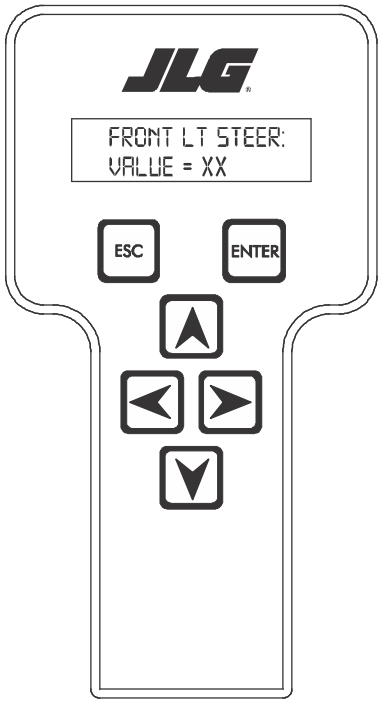

**9.** Press Enter. The screen will read:




**10.** Press Enter. The screen will read:

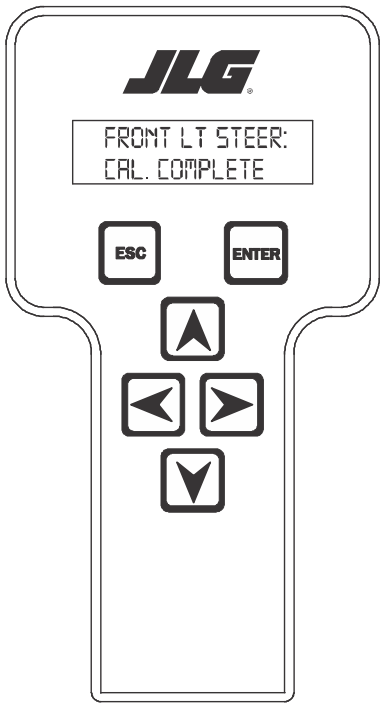



**11.** Press Enter again. The screen will read:



12. Activate the steer control until the tire and wheel are straight in relationship with the chassis, then leave off the control. The display will read FRT LEFT = and show the numeric calibration value for that wheel.

13. Press Enter. The screen will read:




14. Repeat steps 10 thru 12 for left rear steer.

15. Left Rear Steer Calibration will be followed by Right Forward Steer Calibration which will be followed by Right Rear Steer Calibration.

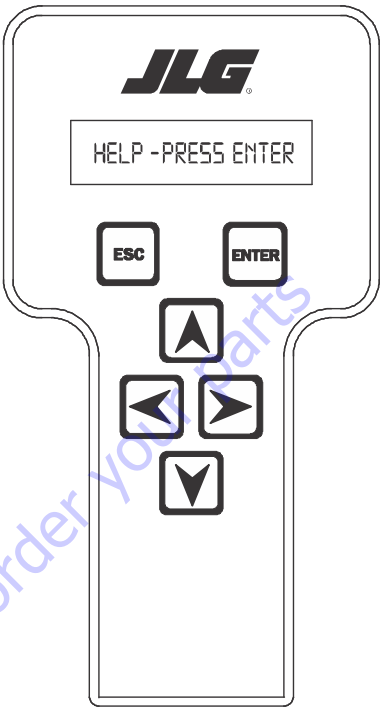
16. After completing all the Steer Calibrations, press ESC twice to go back to CALIBRATIONS.

## 6.13 CALIBRATING DRIVE

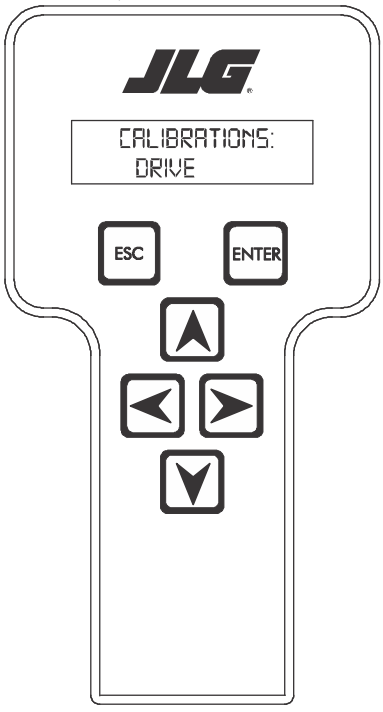
1. Position the Platform/Ground select switch to the Platform position.
2. Plug the analyzer into the connector at the base of the platform control box.


3. Pull out the Emergency Stop switch and Start the engine.

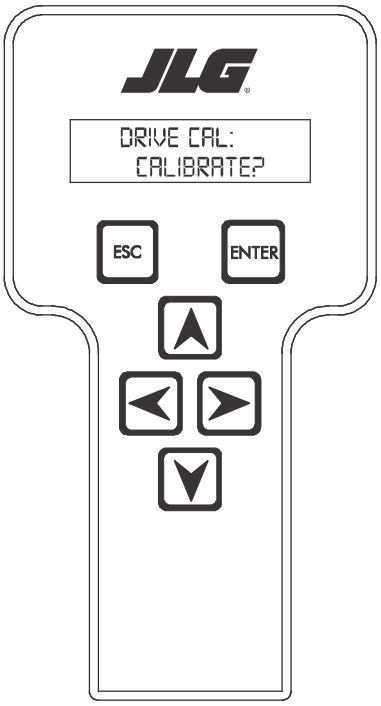
4. The analyzer screen should read:



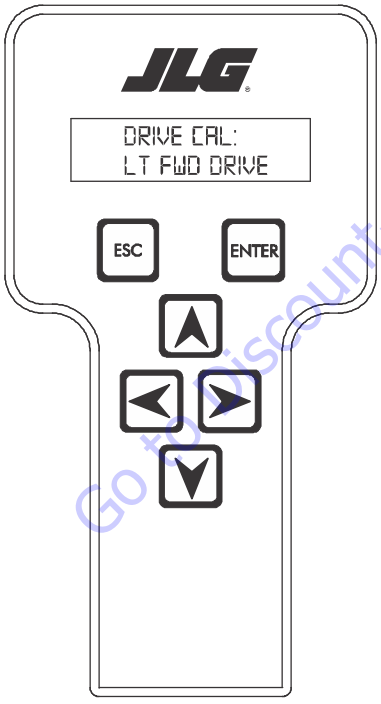

5. Use the arrow button to reach ga. Press Enter.
6. Enter the Access Code, 33271.
7. Use the right Arrow key to reach CALIBRATIONS. Press Enter.
8. Use the arrow keys to reach DRIVE.



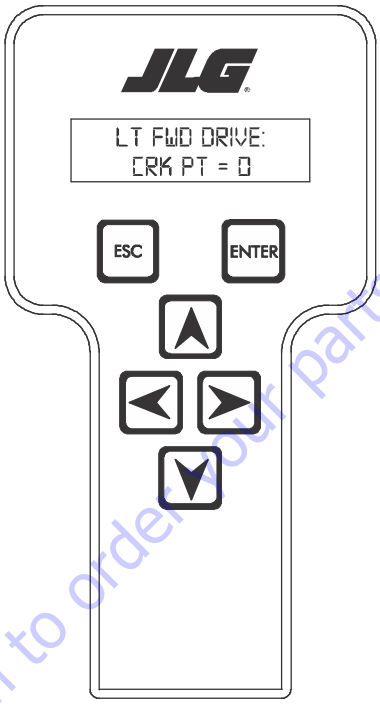
**9.** Press Enter. The screen will read:




**10.** Press Enter again. The screen will read:

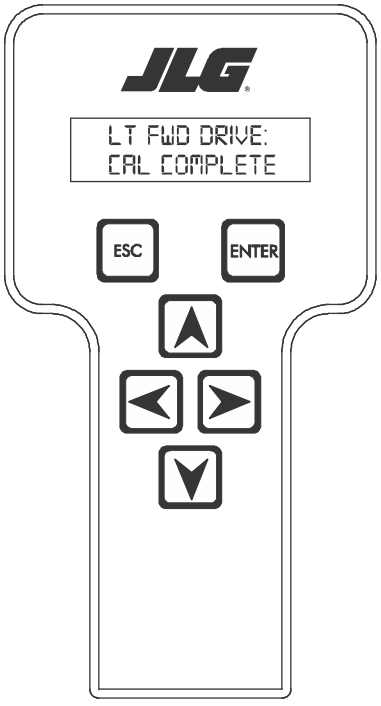



**11.** Press Enter again. The screen will read:

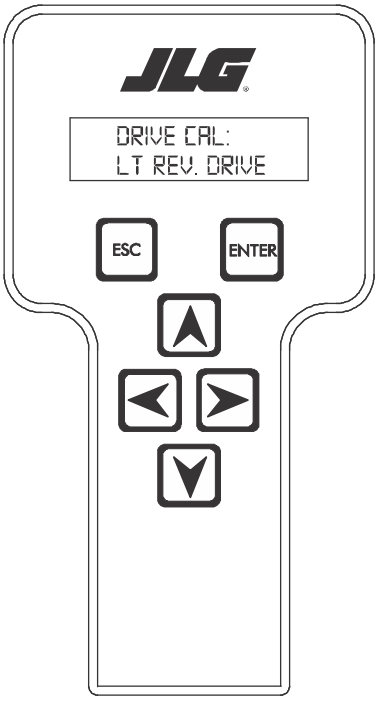



**12.** Activate the Drive Joystick forward full stroke until the machine just begins to move, then leave off the joystick immediately. The display will read CRK PT = and show the numeric crack point value.

**13.** Press Enter. The number displayed will be the value that the crack point is set to. The screen will show:



14. Press Enter. The screen will read:




15. Repeat steps 10 thru 12 for left reverse drive.

16. Left Reverse Drive Calibration will be followed by Right Forward Drive Calibration which will be followed by Right Reverse Calibration.

17. After completing all the Drive Calibrations, press ESC twice to go back to CALIBRATIONS.

## 6.14 CALIBRATING TILT SENSOR

**NOTICE**

**A NEW TILT MODULE WILL ACT AS IF IT IS TILTED ALL OF THE TIME UNTIL THE FOLLOWING PROCEDURE IS PERFORMED.**

**⚠ WARNING**

**DO NOT CALIBRATE THE LEVEL SENSOR EXCEPT ON A LEVEL SURFACE.**

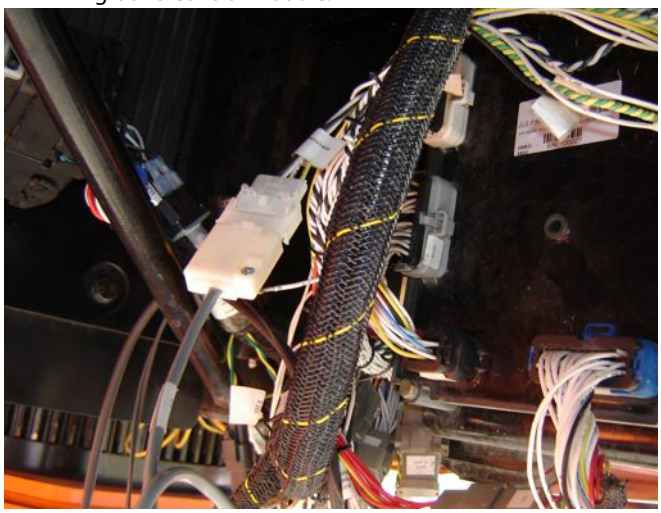
1. Use the following procedure to calibrate the tilt sensor.

   Before the tilt sensor can be calibrated, the following conditions must be met:

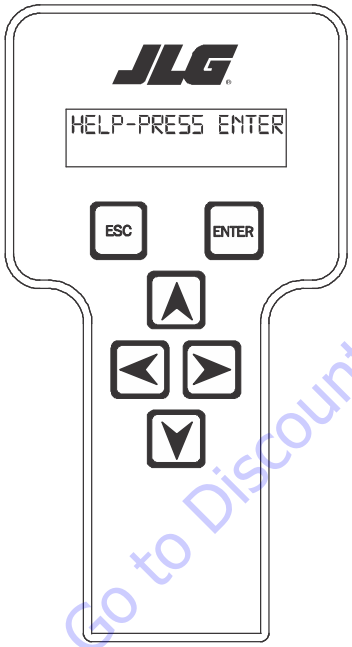
   a. Steering previously calibrated.
   b. Axles extended.
   c. Wheels straight.
   d. Turntable centered.
   e. Boom fully retracted.
   f. Boom angle is less than 45°.
   g. Machine on firm, level ground.

2. Position the Platform/Ground select switch to the Ground position.

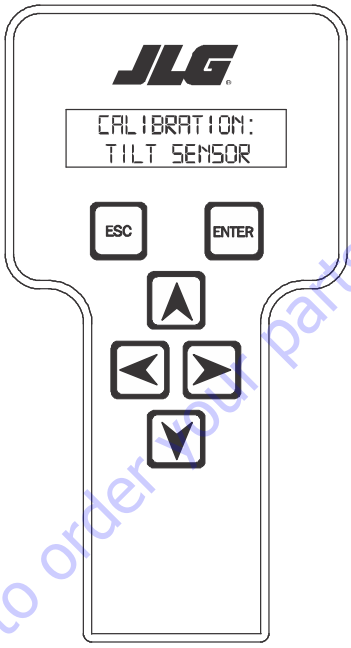
3. Plug the analyzer into the connector coming from the ground control module.



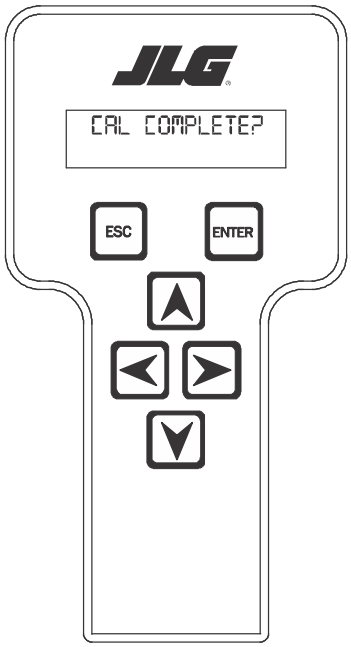
4. Pull out the Emergency Stop switch and start the engine.
5. The analyzer screen should read:




6. Use the arrow button to reach OPERATOR ACCESS. Press Enter.
7. Enter the Access Code, 33271.
8. Use the right Arrow key to reach CALIBRATIONS. Press Enter.
9. Use the arrow keys to reach the TILT SENSOR. The screen should read:




10. Press ENTER.
11. When prompted, swing turntable 180° to opposite end of chassis.
12. Press ENTER. The screen should read:




13. Upon completing swing calibration, swing turntable 180° back to the stowed position.
14. Press ESC twice to go back to CALIBRATIONS.

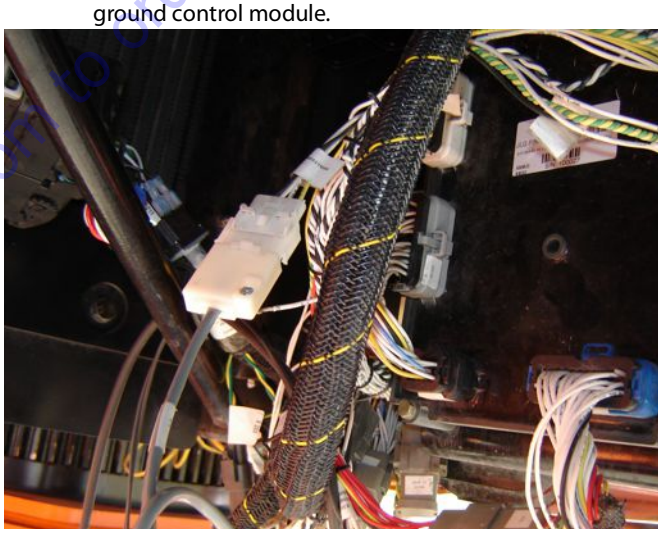
## 6.15 CALIBRATING THE BOOM SENSORS

Use the following step-by-step procedure to calibrate the boom sensors.

***NOTE:*** *If the Enter button is pressed and the calibration procedure does not move on to the next step, this signifies a failed calibration step. There are two additional attempts to complete a failed calibration step. After the third attempt, the JLG Control System assumes there is a sensor issue and will display the failed calibration fault.*

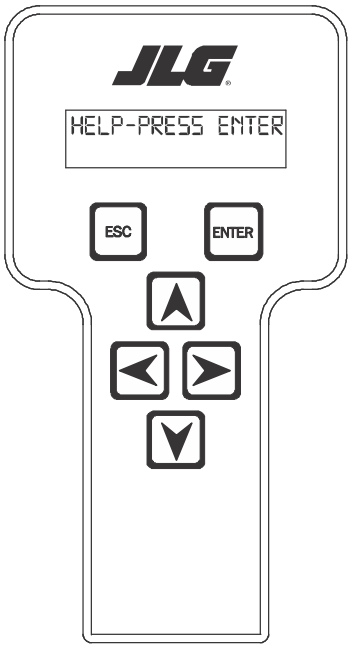
1. Before the boom sensors can be calibrated, the following conditions must be met:
   - **a.** Steering, axle, drive, and hydraulic valve crack points completed, and tilt previously calibrated
   - **b.** Axles Extended
   - **c.** Wheels Straight
   - **d.** Platform Unloaded
   - **e.** Jib Horizontal
   - **f.** Jib Swing Centered
   - **g.** Platform Level
   - **h.** Platform Centered
   - **i.** Turntable Centered
   - **j.** Boom Fully Retracted
   - **k.** Level Ground (within 1.5°)
   - **l.** LSS calibrated (if equipped)
2. Position the Platform/Ground select switch to the Ground position.

3. Plug the analyzer into the connector coming from the ground control module.

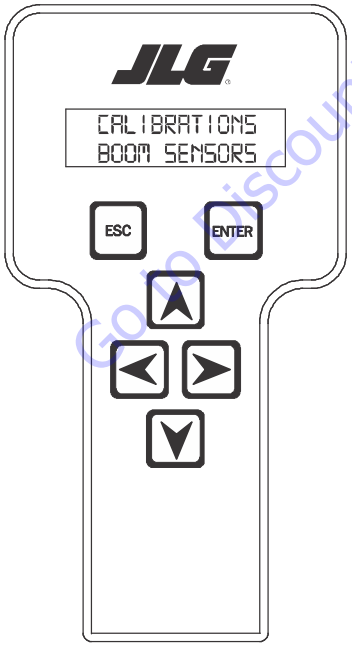


4. Pull out the Emergency Stop switch and start the engine.

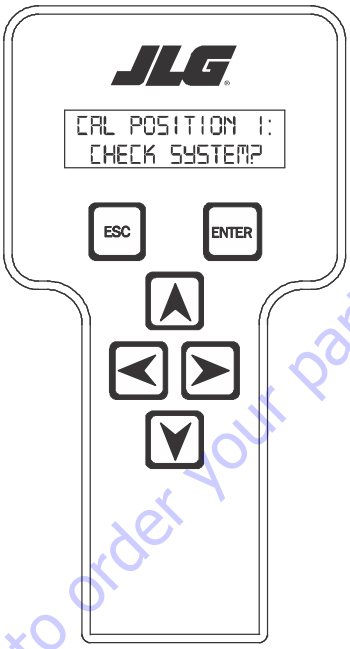
5. The analyzer screen should read:



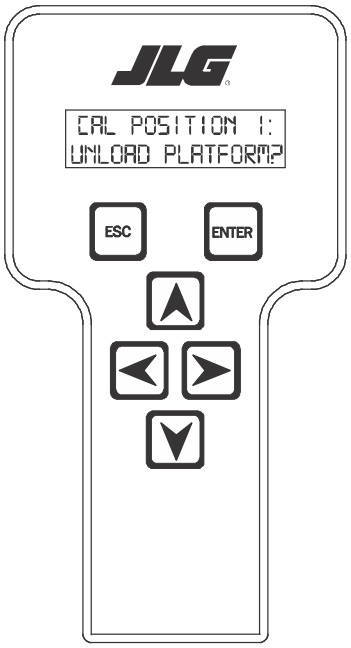

6. Use the arrow button to reach OPERATOR ACCESS. Press Enter.
7. Enter the Access Code, 33271.
8. Use the right Arrow key to reach CALIBRATIONS. Press Enter.
9. Use the arrow keys to reach BOOM SENSORS. The screen should read:




10. Press Enter. The screen will read:




11. After verifying all the conditions listed in step 1 are met, Press Enter. The screen will read:



**12.** After verifying all load (personnel or material) is removed from the platform, Press Enter. The screen will read:

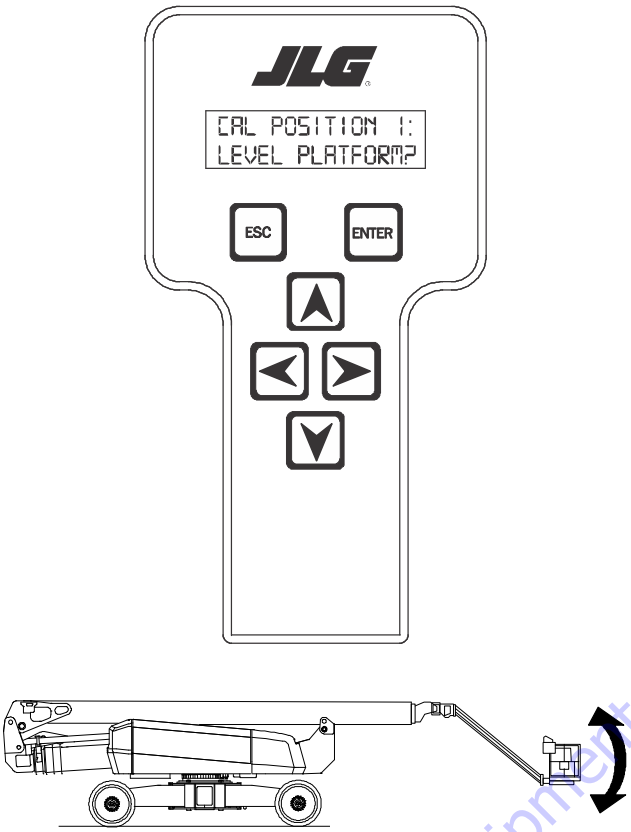
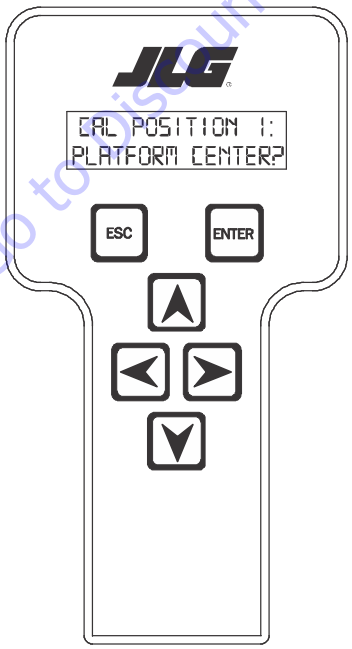





**Figure 6-54. Boom Calibration Position 1 - Level Platform**

**13.** Raise the platform to level. After visually verifying that the platform is level, Press Enter. The screen will read:



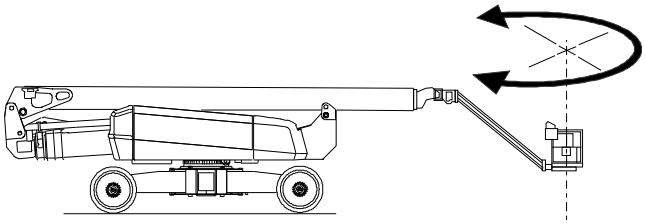
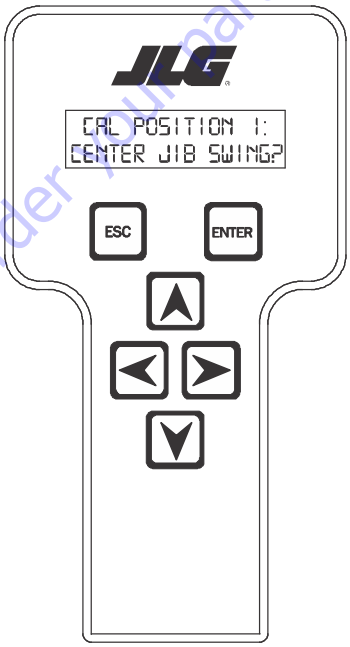



**Figure 6-55. Boom Calibration Position 1 - Center Platform**

**14.** Center the platform. After visually verifying the platform is centered, Press Enter. The screen will read:




***NOTE:*** *If this step does not activate, it signifies the jib is already meeting the calibration requirement to be centered and the step is disabled.*

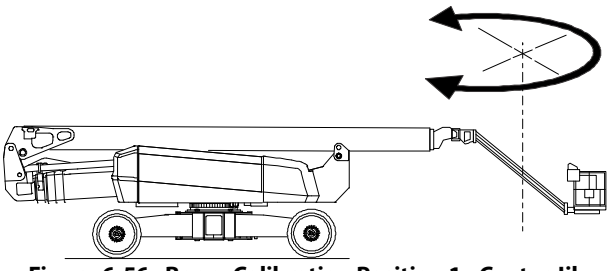
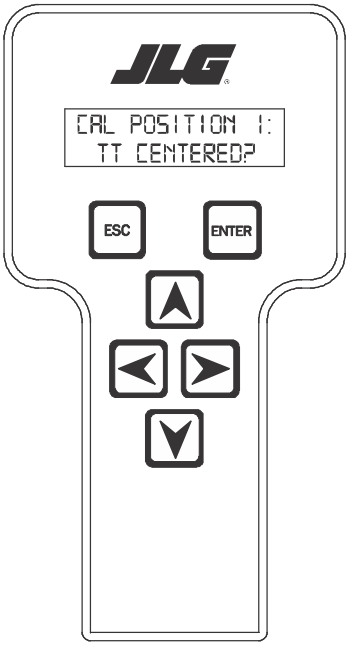


**Figure 6-56. Boom Calibration Position 1 - Center Jib**

**15.** Center the jib. After visually verifying the jib is centered, Press Enter. The screen will read:



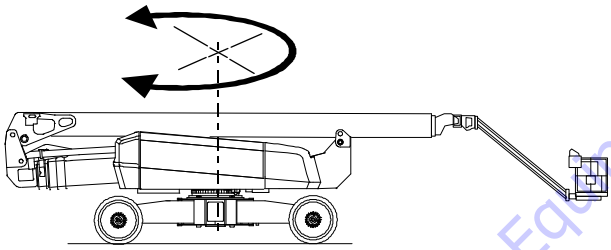
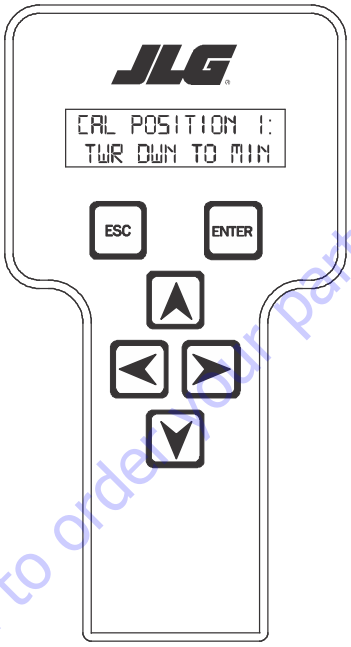



**Figure 6-57. Boom Calibration Position 1 - Turntable Centered**

**16.** Center the turntable. After visually verifying the turntable is centered with the chassis, Press Enter. The screen will read:



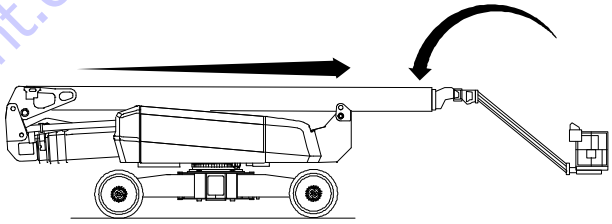
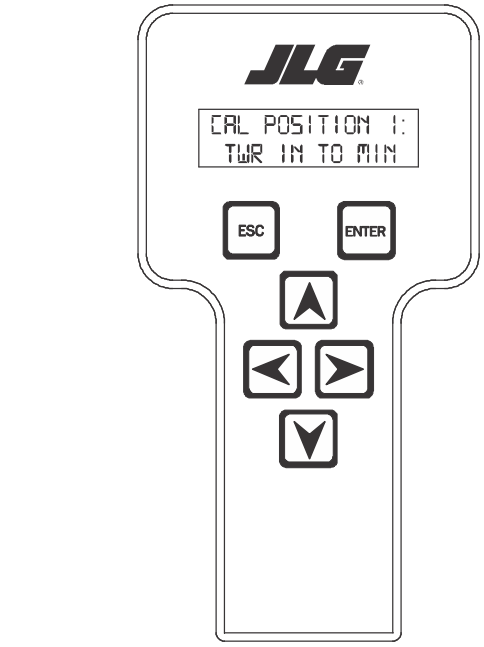



**Figure 6-58. Boom Calibration Position 1 - Tower Down to Minimum**

**17.** Lower the tower boom down to the rest. After visually verifying the tower is lowered, press Enter. The screen will read:



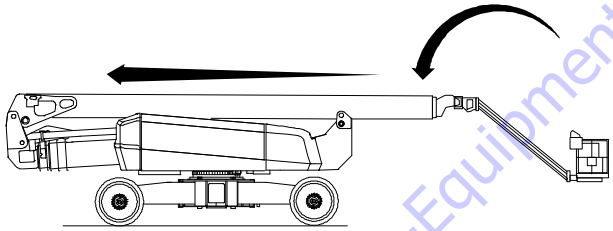
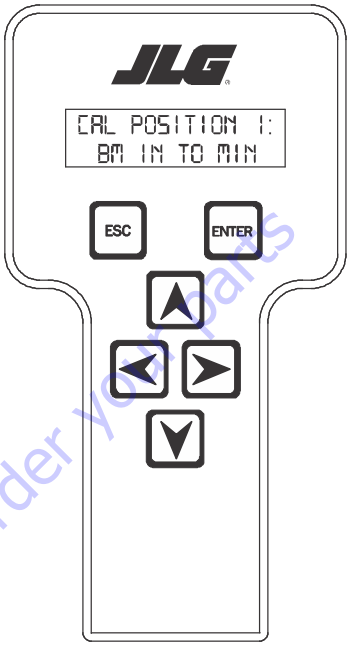



**Figure 6-59. Boom Calibration Position 1 - Tower In to Minimum**

**18.** Fully retract the tower boom. After visually verifying the tower boom is fully retracted, press Enter. The screen will read:



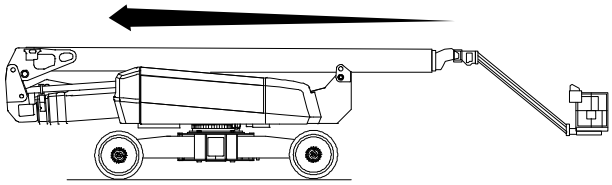
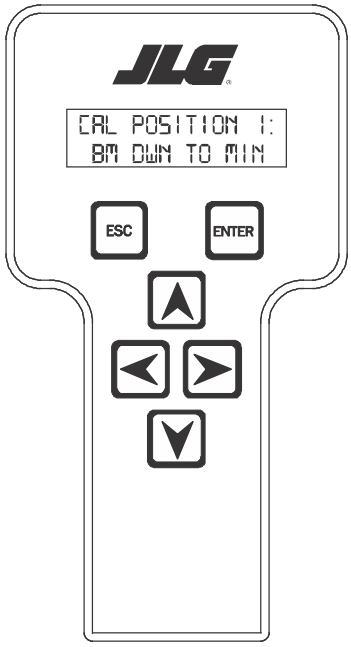



**Figure 6-60. Boom Calibration Position 1 - Boom In to Minimum**

**19.** Fully retract the main boom. After visually verifying the main boom is fully retracted, press Enter. The screen will read:



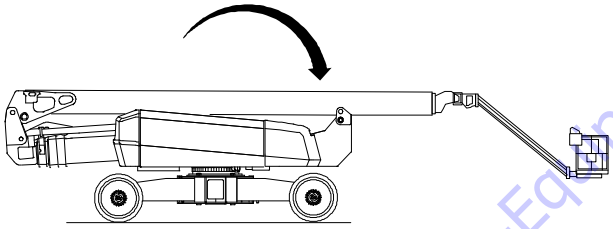
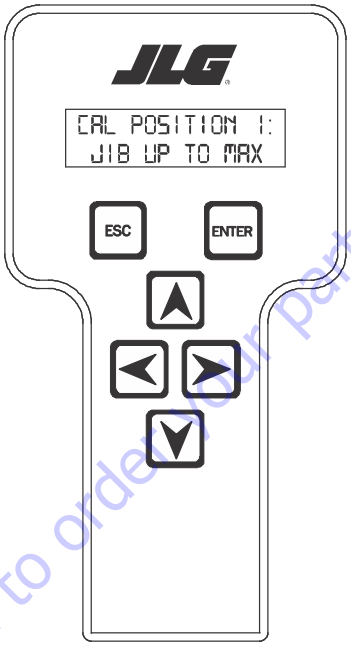



**Figure 6-61. Boom Calibration Position 1 - Boom Down to Minimum**

**20.** Fully lower the main boom to the boom rest. After visually verifying the main boom is fully retracted, press Enter. The screen will read:



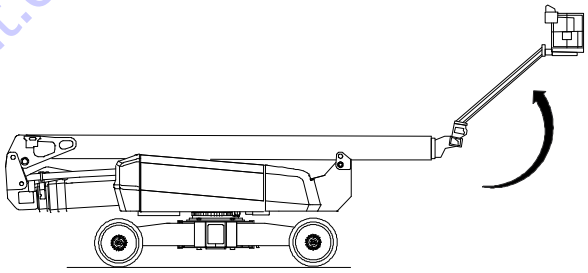
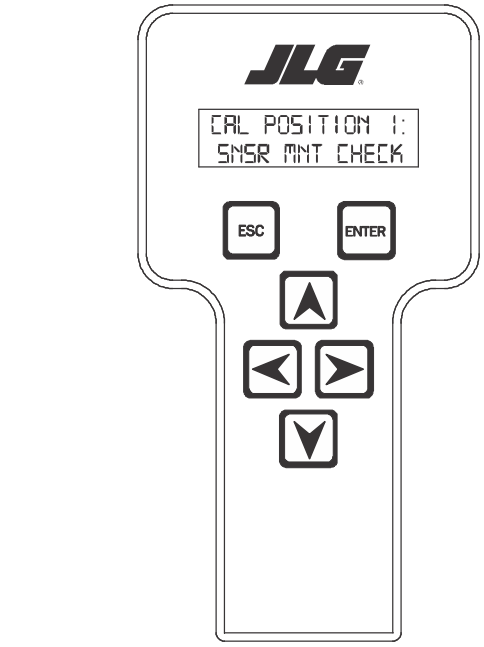



**Figure 6-62. Boom Calibration Position 1 - Jib Up to Maximum**

**21.** Fully raise the jib to maximum elevation. After visually verifying the jib is fully elevated, press Enter. The screen will read:



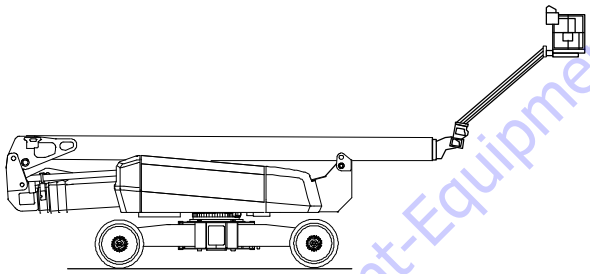
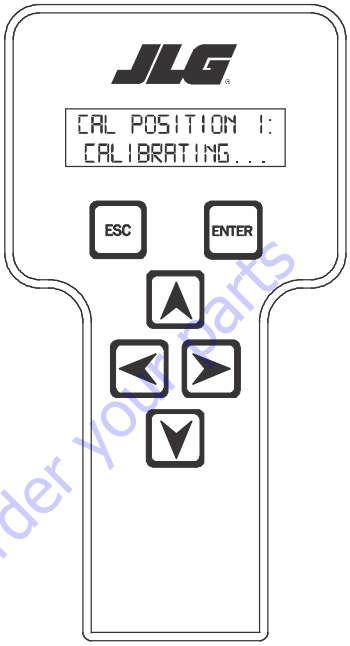



**Figure 6-63. Boom Calibration Position 1 - Sensor Mount Check**

**22.** When the sensor check is complete, press Enter. The screen should read;



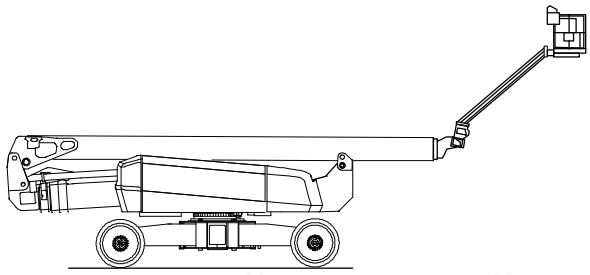
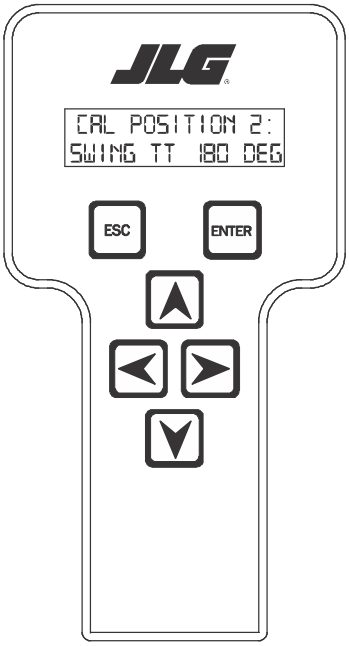



**Figure 6-64. Boom Calibration Position 1 - Calibrating**

**23.** After making sure the machine is in Calibration Position 1, press Enter. The screen will read:



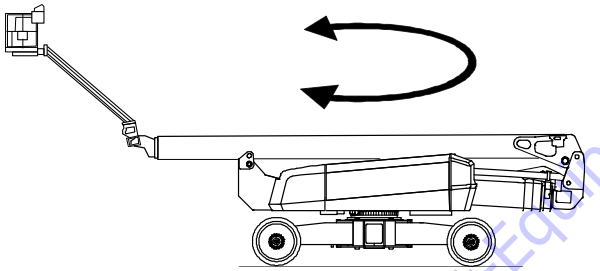
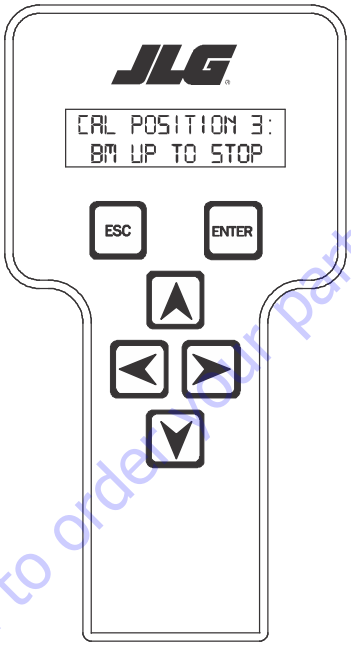



**Figure 6-65. Boom Calibration Position 2 - Swing Turntable 180 Degrees**

**24.** Swing the turntable 180 degrees for Calibration Position 2. When the machine is in that position, press Enter. The screen will read:



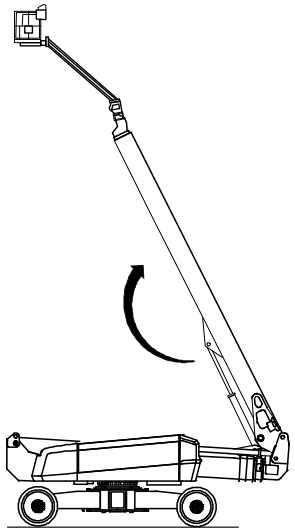
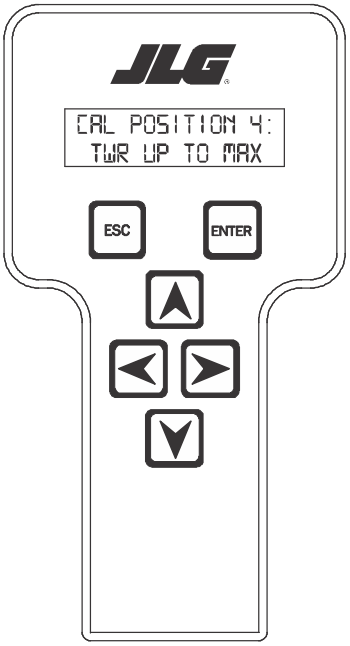



**Figure 6-66. Boom Calibration Position 3 - Boom Up to Stop**

**25.** Raise the main boom up till it stops. When the boom is in that position, press Enter. The screen will read:



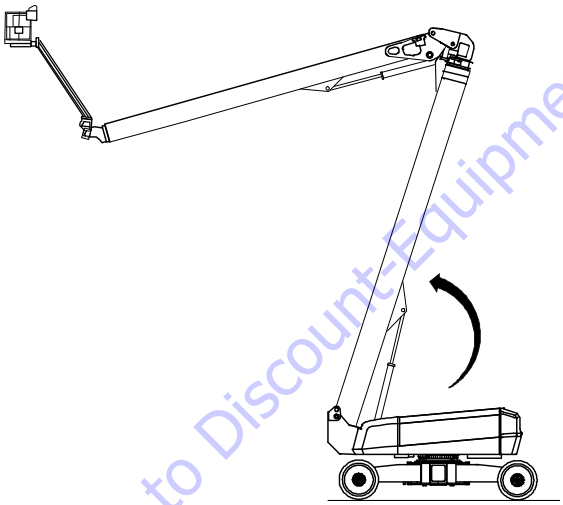
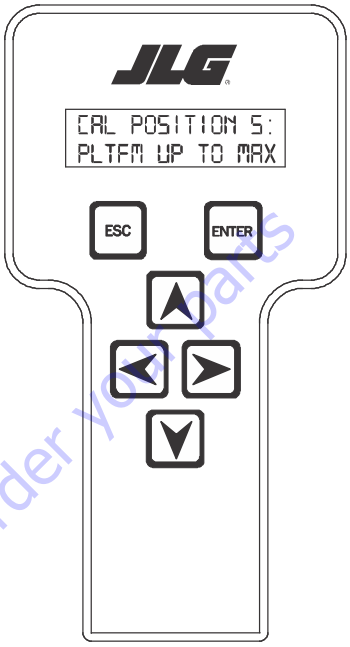



**Figure 6-67. Boom Calibration Position 4 - Tower Up to Maximum**

**26.** Raise the tower boom up to max elevation. When the tower boom is in that position, press Enter. The screen will read:




***NOTE:*** *If calibration fails at this step and the tower is still at max angle, follow the normal boom recovery procedure. Once the point to lift the tower back to its' rest is reached, the Tower Cylinder Angle Sensor Not Detecting Change fault may appear which will cut boom functions out, throwing the BCS Multiple Retrieval Fault. Cycle power and keep trying until the tower starts moving and continue with recovery.*

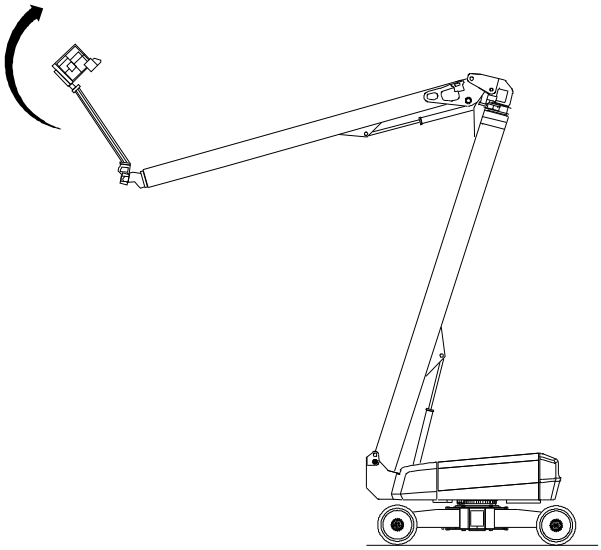
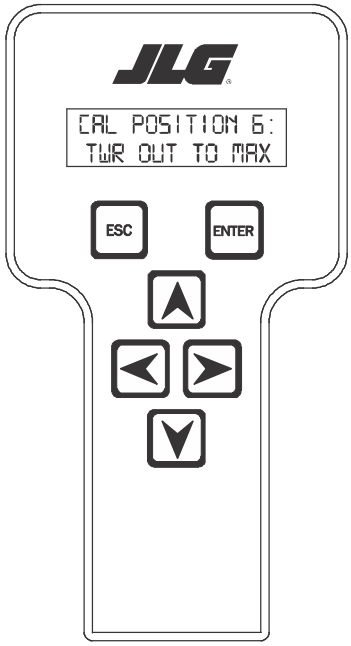


**Figure 6-68. Boom Calibration Position 5 - Platform Up to Maximum**

**27.** Raise the platform up to max elevation. When the platform is in that position, press Enter. The screen will read:



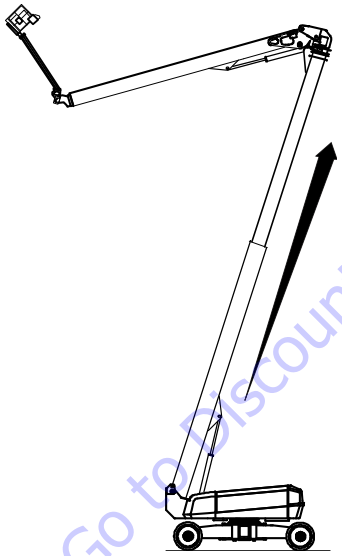
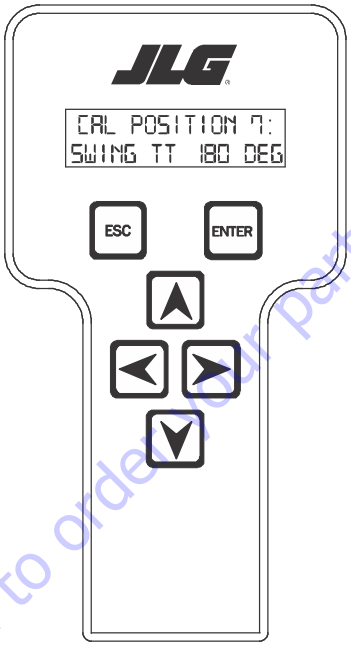



**Figure 6-69. Boom Calibration Position 6 - Tower Out to Maximum**

**28.** Extend the tower boom out the whole way. When the tower boom is in that position, press Enter. The screen will read:



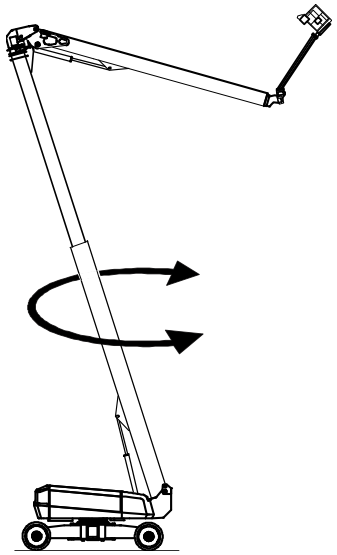
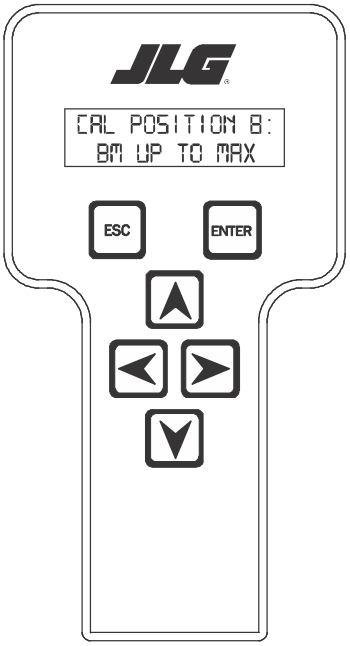



**Figure 6-70. Boom Calibration Position 7 - Swing Turntable 180 Degrees**

**29.** Swing the turntable 180 degrees. When the turntable is in that position, press Enter. The screen will read:



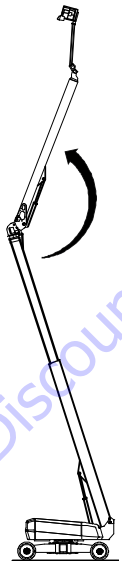
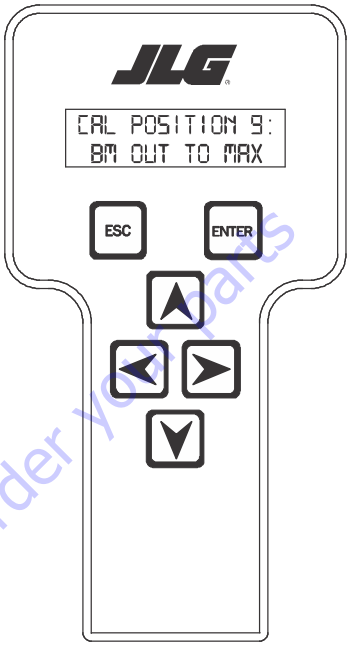



**Figure 6-71. Boom Calibration Position 8 - Boom Up to Maximum**

**30.** Raise the main boom up to max elevation. When the boom is in that position, press Enter. The screen will read:



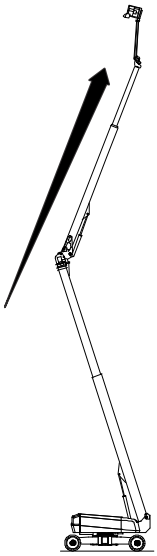
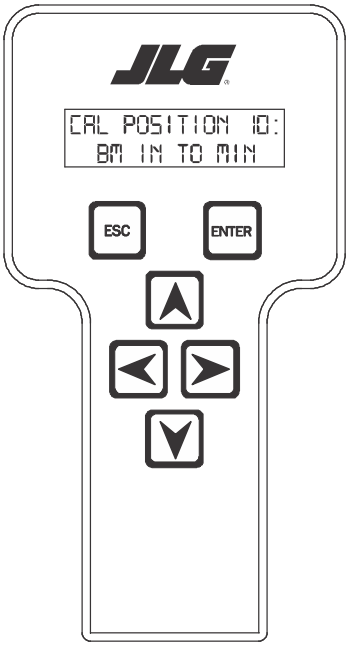



**Figure 6-72. Boom Calibration Position 9 - Boom Out to Maximum**

**31.** Extend the main boom out to full extension. When the boom is in that position, press Enter. The screen will read:



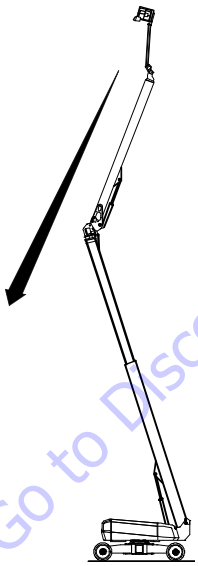
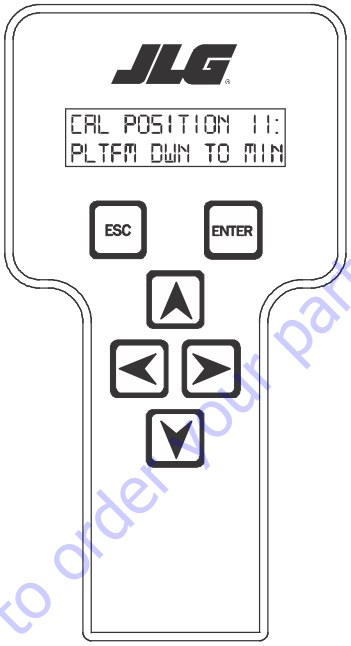



**Figure 6-73. Boom Calibration Position 10 - Boom In to Maximum**

**32.** Fully retract the main boom. When the boom is fully retracted, press Enter. The screen will read:



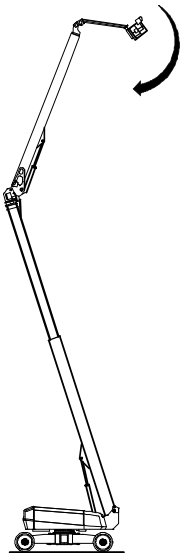
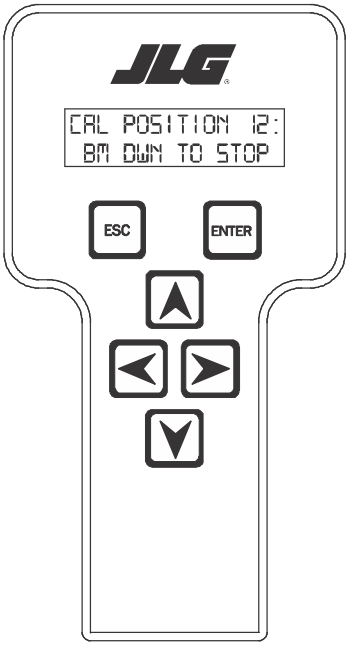



**Figure 6-74. Boom Calibration Position 11 - Platform Down to Minimum**

**33.** Fully lower platform level. When the platform is in that position, press Enter. The screen will read:



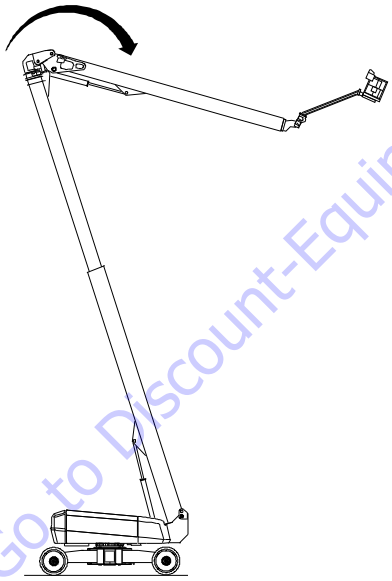
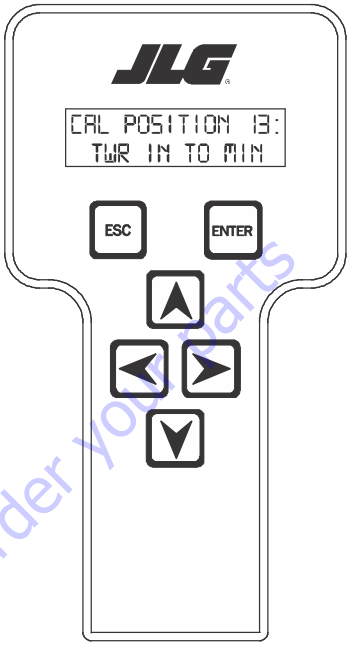



**Figure 6-75. Boom Calibration Position 12 - Boom Down to Stop**

**34.** Lower the main boom till it stops. When the boom is in this position, press Enter. The screen will read:



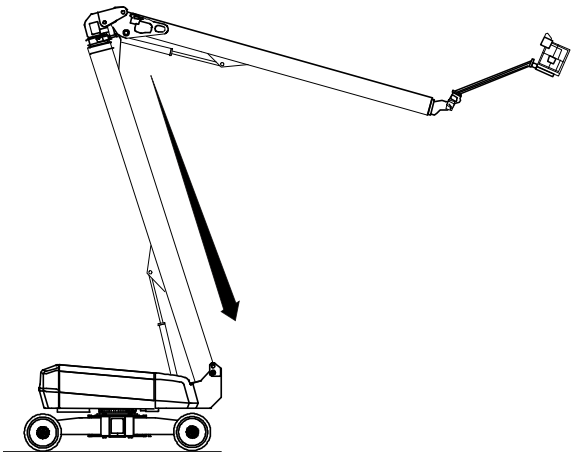
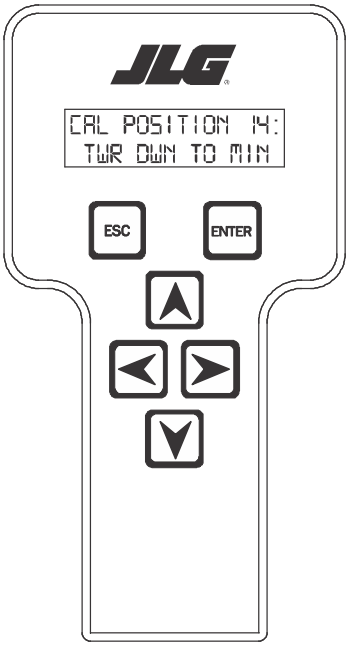



**Figure 6-76. Boom Calibration Position 13 - Tower In to Minimum**

**35.** Retract the tower boom in the whole way. When the boom is in that position, press Enter. The screen will read:



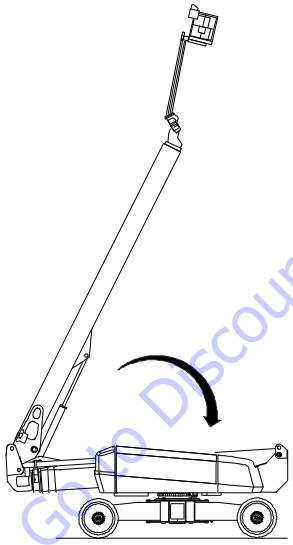
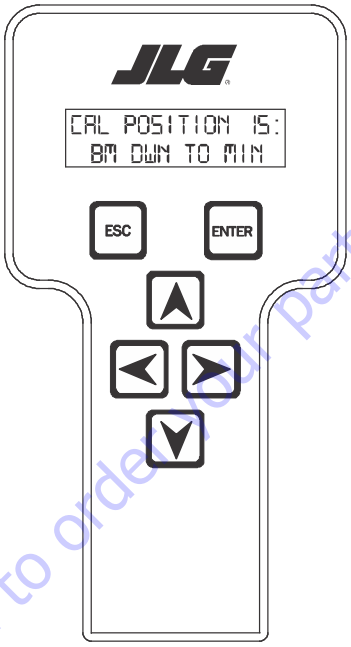



**Figure 6-77. Boom Calibration Position 14 - Tower Down to Minimum**

**36.** Lower the tower boom down to the rest. When the boom is in that position, press Enter. The screen will read:




***NOTE:*** *If the boom is on the rest and a "TWR NOT DN" error message is displayed on the analyzer, function tower down again for at least two seconds before releasing and pressing Enter on the analyzer.*

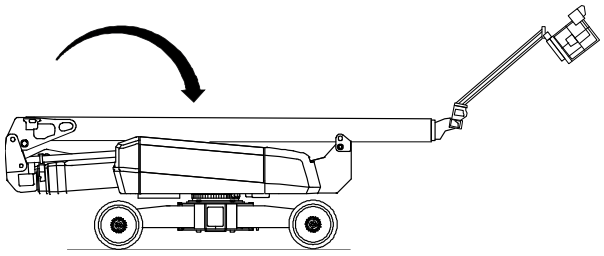
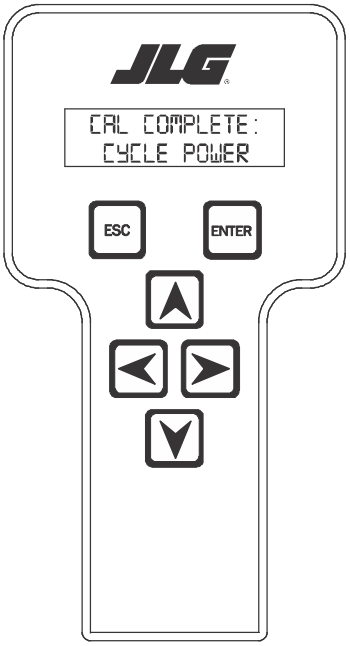


**Figure 6-78. Boom Calibration Position 15 - Boom Down to Minimum**

**37.** Lower the main boom down to the rest. When the boom is in that position, press Enter. The screen will read:



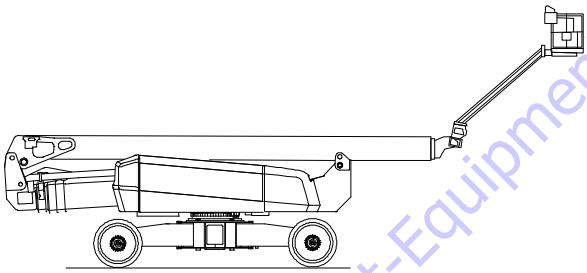
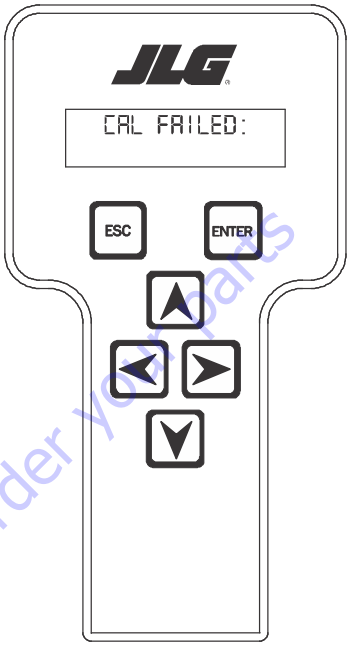



**Figure 6-79. Boom Calibration Complete - Cycle Power**

**38.** Calibration is complete and the Emergency Stop must be cycled for the calibration to take effect. If the calibration fails, the screen will read:



## 6.16 BOOM SENSOR CALIBRATION FAULTS

**Table 6-7. Boom Sensor Calibration Faults**

| Calibration Position | | Fault Text | Extended Fault Text | Fault Trigger |
|---|---|---|---|---|
| CAL POSITION 1 | CHECK SYSTEM? | SEE HELP MENU | See Analyzer Help Menu | Fault will be active in the HELP menu on the analyzer |
| | | REMOVE DONGLE | Remove Dongle | The UGM sees the CAN Dongle on the CANbus and is reporting the Dongle DTC to be active, remove CAN dongle |
| | | LEVEL MACHINE | Level Machine | Chassis Tilt > 1.5° |
| | | EXTEND AXLES | Extend Axles | Verifies axles are fully deployed |
| | | CENTER WHEELS | Center Wheels | Wheels must be less than ±10° turned |
| | UNLOAD PLATFORM? | PLTFM NOT EMPTY | Platform Not Empty | If LSS is enabled the platform load must be less than 100lbs |
| | LEVEL PLATFORM? | N/A | N/A | N/A |
| | PLATFORM CENTER? | N/A | N/A | N/A |
| | CENTER JIB SWG? | JIB SW FLT | Jib Switch Fault | Jib is not reading inline. The Inline Switch or the Stowed switch is reporting the jib is swung. |
| | TT CENTERED? | ALIGN TURNTABLE | Align Turntable | The DOS Switch is reporting the turntable is not inline |
| | | TT SW FLT | Turn Table Switch Fault | The DOS Switch is reporting the turntable is not inline |
| | TWR DWN TO MIN | TWR CYL ANG FLT | Tower Cylinder Angle Fault | Looks at tower cylinder angle sensor 1 to be reporting below 23% Duty Cycle if uncalibrated or tower angle to be below 5 degrees if the tower cylinder angle sensor is not reporting a fault. If there is a faulted tower cylinder angle sensor then the max tower angle gravity sensor angle is used and the chassis tilt y axis is added and that angle has to be below 0 degrees. |
| | TWR IN TO MIN | TWR NOT DN | Tower Not Down | Looks at the position of the tower lift angle, using tower cylinder angle sensors, from previous step to end of the current step, if it changes more than the standard tolerance the tower was not down |
| | | TWR LEN PRX FLT | Tower Length Transport Proximity Sensor Fault | Looks at the max tower length sensor value and verifies it is less than the tower length retracted threshold plus 3.2 inches if the tower length sensors are not reporting a fault. If there is a tower length sensor fault then the tower length proximity sensor is used and the NC = OPEN and NO = CLOSED. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| | BM IN TO MIN | TWR NOT IN | Tower Not In | Looks at the position of the tower telescope length, using tower length sensors, from previous step to end of the current step, if it changes more than the standard tolerance the tower was not in |
| | | BM LEN PRX FLT | Boom Length Transport Proximity Sensor Fault | Looks at the max boom length sensor value and verifies it is less than the boom length retracted threshold plus 3.2 inches if the boom length sensors are not reporting a fault. If there is a boom length sensor fault then the boom length proximity sensor is used and the NC = OPEN and NO = CLOSED. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| | BM DWN TO MIN | BM NOT IN | Boom Not In | Looks at the position of the boom telescope length, using boom length sensors, from previous step to end of the current step, if it changes more than the standard tolerance the boom was not in |
| | | BM ANG PRX FLT | Boom Angle Transport Proximity Sensor Fault | Looks at max boom angle sensor value and verifies it is less than 0 degrees if the boom angle protractors are not reporting a fault and DTC 8486 is not active. If there is a boom angle protractor fault or DTC 8486 is active then the max boom angle sensor value is verified against the calibrated boom angle transport trip point. If boom sensors have not been calibrated then the boom angle proximity sensor is used and the NC = OPEN and NO = CLOSED. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| | JIB UP TO MAX | BM NOT DN | Boom Not Down | Looks at the position of the boom lift angle, using the boom angle protractor sensors, from previous step to end of the current step, if it changes more than the standard tolerance the tower was not down |
| | SNSR MNT CHECK | CYL ANG MNT FLT | Tower Cylinder Angle Mounting Fault | All these faults take the raw nominal minimum reading and verify that the sensor is reporting within plus/minus the mounting check tolerance. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |

**Table 6-7. Boom Sensor Calibration Faults**

| Calibration Position | | Fault Text | Extended Fault Text | Fault Trigger |
|---|---|---|---|---|
| | | TWR ANG MNT FLT | Tower Angle Gravity Mounting Fault | |
| | | TWR LEN MNT FLT | Tower Length Mounting Fault | |
| | | BM ANG MNT FLT | Boom Angle Mounting Fault | |
| | | BM LEN MNT FLT | Boom Length Mounting Fault | |
| | | PLT ANG MNT FLT | Platform Angle Mounting Fault | |
| | CALIBRATING… | N/A | N/A | N/A |
| CAL POSITION 2 | SWING TT 180 DEG | DRIVE ORNT SW | Drive Orientation Switch failure | The DOS Switch is still reporting the machine inline. |
| | | TWR ANG1 FAULT | Tower Angle Gravity Sensor 1 Fault | The lower calibration angle for sensor 1 is outside the allowable raw nominal minimum value plus/minus the standard tolerance. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| | | TWR ANG2 FAULT | Tower Angle Gravity Sensor 2 Fault | The lower calibration angle for sensor 2 is outside the allowable raw nominal minimum value plus/minus the standard tolerance. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| | | TWR ANG DISAGR | Tower Angle Gravity Disagreement | Verifies that the ground slope detected by the tower angle sensors is less than 0.9 % duty cycle (less than 1 degree). This ground slope verification is used when calibrating the upper limit of the tower angle |
| CAL POSITION 3 | BM UP TO STOP | BL RD PRS HGH | Boom Lift Rod Pressure High | The Boom Lift Rod side pressure transducer detected a pressure above the alotted seal pressure threshold. Refer to "Cal Lmts, Thrshlds, Other Info" tab for thresholds |
| | | BM ANG PRX FLT | Boom Angle Transport Proximity Sensor Fault | Compares the trip point position of the Boom Angle Transport Proximity sensor compaired to Boom Angle Protractor Sensor 2 to the expected value provided by design. Refer to "Cal Lmts, Thrshlds, Other Info" tab for Limit |
| CAL POSITION 4 | TWR UP TO MAX | TL RD PRS HGH | Tower Lift Rod Pressure High | One of the Tower Lift Rod side pressure transducers detected a pressure above the alotted seal pressure threshold. Refer to "Cal Lmts, Thrshlds, Other Info" tab for thresholds |
| | | TWR ANG1 FAULT | Tower Angle Gravity Sensor 1 Fault | The higher calibration angle for tower angle gravity sensor 1 is outside the allowable raw nominal maximum value plus/minus the standard tolerance. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| | | TWR ANG2 FAULT | Tower Angle Gravity Sensor 2 Fault | The higher calibration angle for tower angle gravity sensor 2 is outside the allowable raw nominal maximum value plus/minus the standard tolerance. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| | | CYL ANG FAULT | Tower Cylinder Angle Sensor Fault | The higher calibration angle for the tower cylinder angle sensor is reporting outside the raw nominal maximum reading plus/minus the standard tolerance. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| CAL POSITION 5 | PLTFM UP TO MAX | TL RD PRS HGH | Tower Lift Rod Pressure High | One of the Tower Lift Rod side pressure transducers detected a pressure above the alotted seal pressure threshold. Refer to "Cal Lmts, Thrshlds, Other Info" tab for thresholds |
| | | TWR NOT UP | Tower Not Up | Looks at the position of the tower cylinder angle, using tower cylinder angle sensors, from previous step to end of the current step, if it changes more than the standard tolerance the tower was not up |
| | | PLTFM ANG PR FLT | Platform Angle Protractor Fault | The higher calibration angle for the platform protractor angle sensor is reporting outside the raw nominal maximum reading plus/minus the standard tolerance. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |

**Table 6-7. Boom Sensor Calibration Faults**

| Calibration Position | | Fault Text | Extended Fault Text | Fault Trigger |
|---|---|---|---|---|
| CAL POSITION 6 | TWR OUT TO MAX | TWR LEN1 FAULT | Tower Length Sensor 1 Fault | The higher calibration length for tower length sensor 1 is outside the allowable raw nominal maximum value plus/minus the standard tolerance. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| | | TWR LEN2 FAULT | Tower Length Sensor 2 Fault | The higher calibration length for tower length sensor 2 is outside the allowable raw nominal maximum value plus/minus the standard tolerance. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| | | PLTFM NOT UP | Platform Not Up | Looks at the position of the platform angle, using platform angle protractor, from previous step to end of the current step, if it changes more than the standard tolerance the platform was not up |
| | | TWR LEN PRX FLT | Tower Length Transport Proximity Sensor Fault | Compares the trip point position of the Tower Length Transport Proximity sensor to Tower Length Sensor 1 to the expected value provided by design. Refer to "Cal Lmts, Thrshlds, Other Info" tab for Limit |
| | | TT RD PRS HGH | Tower Telescope Pressure High | The Tower Telescope Rod side pressure transducer detected a pressure above the alotted seal pressure threshold. Refer to "Cal Lmts, Thrshlds, Other Info" tab for thresholds |
| CAL POSITION 7 | SWING TT 180 DEG | TWR NOT OUT | Tower Not Out | Looks at the position of the tower telescope length, using tower length sensor 1, from previous step to end of the current step, if it changes more than the standard tolerance the tower was not out |
| | | NO DOS SW CHG | No DOS Switch State Change | The DOS Switch is still reporting the machine swung 180 degrees out of line. |
| CAL POSITION 8 | BM UP TO MAX | BL RD PRS HGH | Boom Lift Rod Pressure High | The Boom Lift Rod side pressure transducer detected a pressure above the alotted seal pressure threshold. Refer to "Cal Lmts, Thrshlds, Other Info" tab for thresholds |
| | | TWR NOT OUT | Tower Not Out | Looks at the position of the tower telescope length, using tower length sensor 1, from previous step to end of the current step, if it changes more than the standard tolerance the tower was not out |
| | | BM ANG1 FLT | Boom Angle Protractor Sensor 1 Fault | The higher calibration angle for boom angle protractor sensor 1 is outside the allowable raw nominal maximum value plus/minus the standard tolerance. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| | | BM ANG2 FLT | Boom Angle Protractor Sensor 2 Fault | The higher calibration angle for boom angle protractor sensor 2 is outside the allowable raw nominal maximum value plus/minus the standard tolerance. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| CAL POSITION 9 | BM OUT TO MAX | BM NOT UP | Boom Not Up | Looks at the position of the boom angle, using boom angle protractor sensors, from previous step to end of the current step, if it changes more than the standard tolerance the tower was not up |
| | | BL RD PRS HGH | Boom Lift Rod Pressure High | The Boom Lift Rod side pressure transducer detected a pressure above the alotted seal pressure threshold. Refer to "Cal Lmts, Thrshlds, Other Info" tab for thresholds |
| | | BM LEN1 FLT | Boom Length Sensor 1 Fault | The higher calibration length for boom length sensor 1 is outside the allowable raw nominal maximum value plus/minus the standard tolerance. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| | | BM LEN2 FLT | Boom Length Sensor 2 Fault | The higher calibration length for boom length sensor 2 is outside the allowable raw nominal maximum value plus/minus the standard tolerance. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| | | BM LEN PRX FLT | Boom Length Transport Proximity Sensor Fault | Compares the trip point position of the Boom Length Transport Proximity sensor to Boom Length Sensor 1 to the expected value provided by design. Refer to "Cal Lmts, Thrshlds, Other Info" tab for Limit |
| CAL POSITION 10 | BM IN TO MIN | BM LEN PRX FLT | Boom Length Transport Proximity Sensor Fault | Compares the calibrated trip point position of the Boom Length Transport Proximity sensor to Boom Length Sensor 1 to the expected value provided by design. Refer to "Cal Lmts, Thrshlds, Other Info" tab for Limit |
| | | AIR IN TELE CYL | Air Trapped in Boom Telescope Cylinder | Looks at the change in boom telescope length, using boom length sensor 1, to check for trapped air in the telescope cylinder after the function has completed --> **Currently not active fault in the calibraiton procedure** |

**Table 6-7. Boom Sensor Calibration Faults**

| Calibration Position | | Fault Text | Extended Fault Text | Fault Trigger |
|---|---|---|---|---|
| CAL POSITION 11 | PLTFM DWN TO MIN | BM NOT IN | Boom Not In | Looks at the position of the boom telescope length, using boom length sensors, from previous step to end of the current step, if it changes more than the standard tolerance the boom was not in |
| | | PLTFM ANG PR FLT | Platform Angle Protractor Fault | The lower calibration angle for the platform protractor angle sensor is reporting outside the raw nominal minimum reading plus/minus the standard tolerance. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| CAL POSITION 12 | BM DWN TO STOP | BM ANG PRX FLT | Boom Angle Transport Proximity Sensor Fault | Compares the calibrated trip point position of the Boom Angle Transport Proximity sensor compaired to Boom Angle Protractor Sensor 2 to the expected value provided by design. Refer to "Cal Lmts, Thrshlds, Other Info" tab for Limit |
| | | TL RD PRS HGH | Tower Lift Rod Pressure High | One of the Tower Lift Rod side pressure transducers detected a pressure above the alotted seal pressure threshold. Refer to "Cal Lmts, Thrshlds, Other Info" tab for thresholds |
| CAL POSITION 13 | TWR IN TO MIN | TL RD PRS HGH | Tower Lift Rod Pressure High | One of the Tower Lift Rod side pressure transducers detected a pressure above the alotted seal pressure threshold. Refer to "Cal Lmts, Thrshlds, Other Info" tab for thresholds |
| | | TWR LEN PRX FLT | Tower Length Transport Proximity Sensor Fault | Compares the calibrated trip point position of the Tower Length Transport Proximity sensor to Tower Length Sensor 1 to the expected value provided by design. Refer to "Cal Lmts, Thrshlds, Other Info" tab for Limit |
| | | AIR IN TELE CYL | Air Trapped in Tower Telescope Cylinder | Looks at the change in tower telescope length, using tower length sensor 1, to check for trapped air in the telescope cylinder after the function has completed --> **Currently not active fault in the calibration procedure** |
| | | TWR NOT IN | Tower Not In | Looks at the max tower length sensor value and verifies it is less than the tower length retracted threshold plus 3.2 inches if the tower length sensors are not reporting a fault. If there is a tower length sensor fault then the tower length proximity sensor is used and the NC = OPEN and NO = CLOSED. Refer to "Cal Lmts, Thrshlds, Other Info" tab for expected values and tolerances |
| CAL POSITION 14 | TWR DWN TO MIN | TWR NOT DN | Tower Not Down | Looks at the tower cylinder angle to be less than 1.9 degrees or tower cylinder angle sensor 1 to be less than 21.5 % duty cycle if uncalibrated and the tower down command has been active for at least 1 second and tower cylinder angle does not change for 0.5 seconds and tower cylinder angle sensors not reporting a fault |
| CAL POSITION 15 | BM DWN TO MIN | BM NOT DN | Boom Not Down | Looks at the boom angle protractor sensor 2 raw duty cycle and if the sensor is reporting below 13.3 % Duty Cyle and the tower is on the rest and the Boom angle sensors are not reporting a fault or the booms are not calibrated |
| CAL COMPLETE: | CYCLE POWER | N/A | N/A | N/A |
| CAL FAILED: | <Failure Reason> | N/A | N/A | N/A |

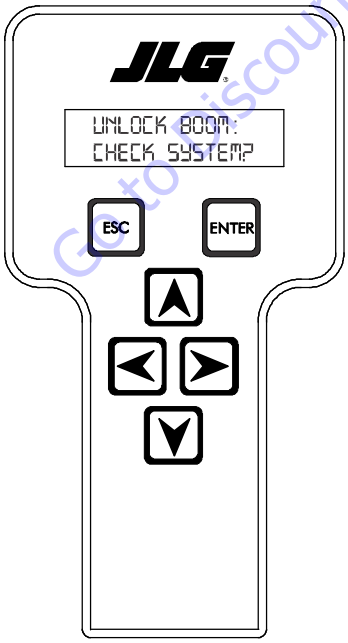
## 6.17 BOOM UNLOCK

Before performing the Boom Unlock procedure, the machine must meet the following conditions.

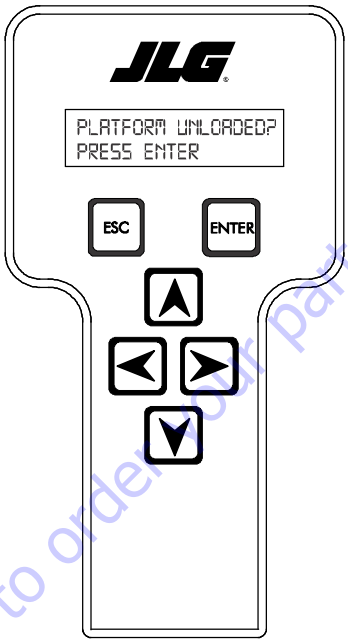
1. The following calibrations must be completed successfully:
   - **a.** Axle
   - **b.** Chassis Tilt Sensor
   - **c.** LSS (if enabled)
   - **d.** Boom Sensors
2. The machine must meet the following qualifications:
   - **a.** Engine Running
   - **b.** Ground Control Station Selected
   - **c.** Machine in Transport Position
   - **d.** Chassis Tilt < ±1.5°
   - **e.** Steer Sensors < ±10°
   - **f.** Axles Extended
3. There must be no faults on the following valves:
   - **a.** Park Brake Valve
4. There must be no faults on the following sensors:
   - **a.** Axle Sensors

### Procedure

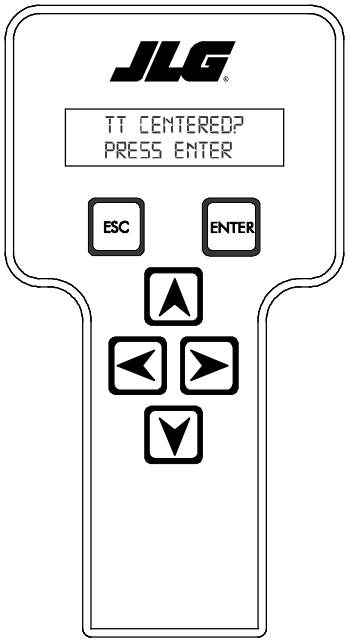
1. Using the analyzer, scroll to the Service Modes Menu, and select Unlock Boom. Press ENTER. The screen will read:



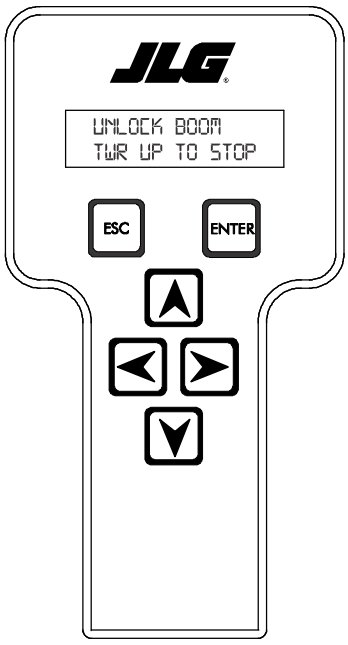

2. Press ENTER. The screen will read:



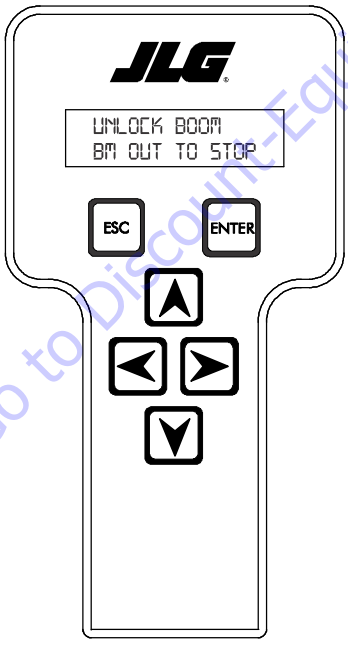

3. Check to make sure the platform is unloaded. If it is, press ENTER. The screen will read:



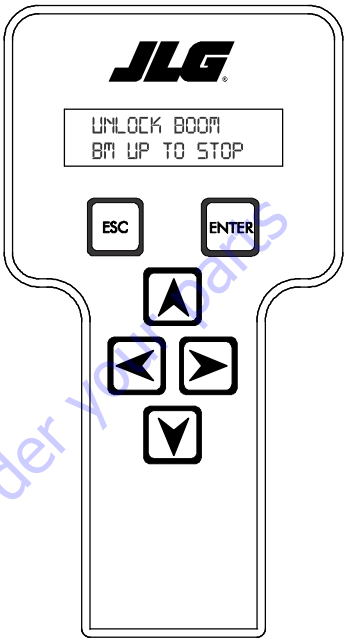
4. Check to make sure the turntable is centered. If it is, press ENTER (ENTER). The screen will read:



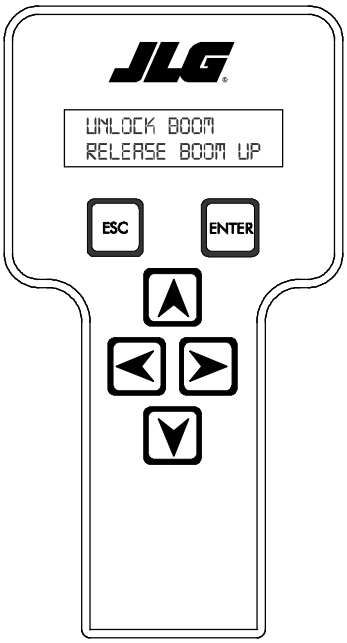

5. Activate Tower Boom Up until the tower boom stops. Once the tower stops and no faults are present, the screen will read:



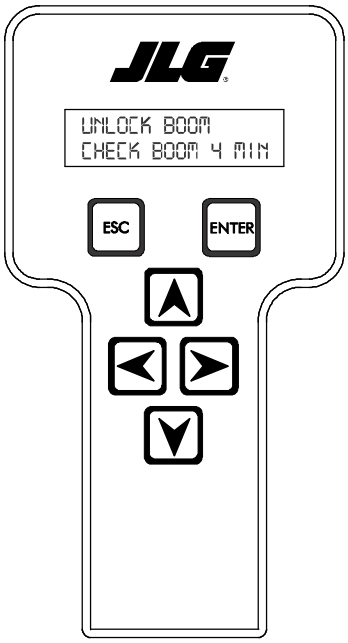

6. Activate Main Boom Extend until the boom stops. Once the boom stops and no faults are present, the screen will read:



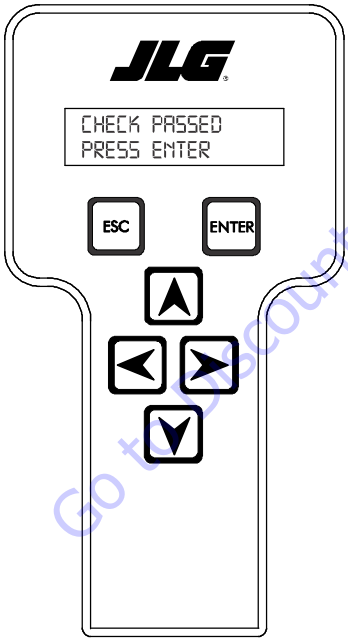

7. Activate Main Boom Lift. When the boom stops and the boom up switch is still applied, the screen will read:



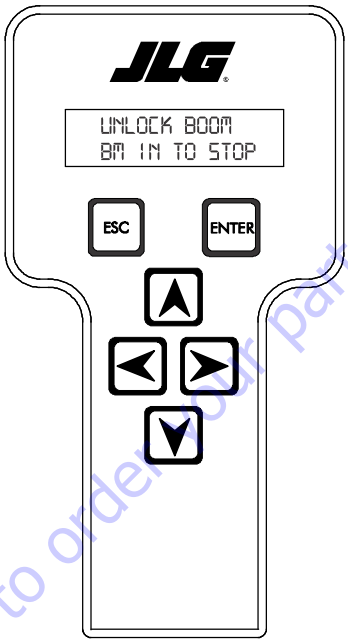
**8.** Release the main boom lift switch. The screen will read:



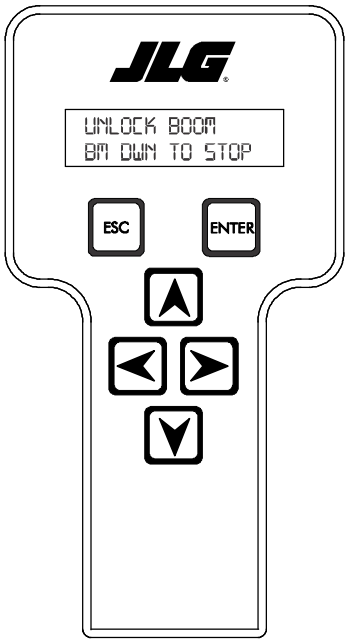

**9.** The Control System will check the boom for movement for 4 minutes. After 4 minutes, if functioning properly, the screen will read:



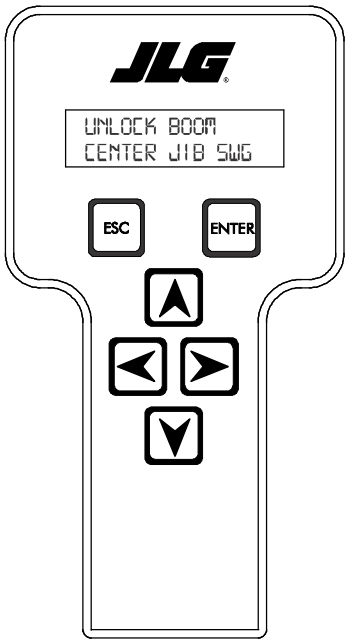

**10.** Press ENTER. The screen will read:




**11.** Activate Main Boom Retract until the boom stops. Once boom telescope stops and if no faults are present the screen will read:



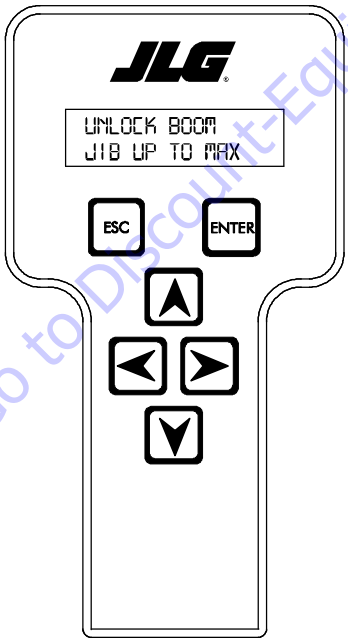
**12.** Activate Main Boom Lower until the boom stops. If no faults are present, the screen will read:



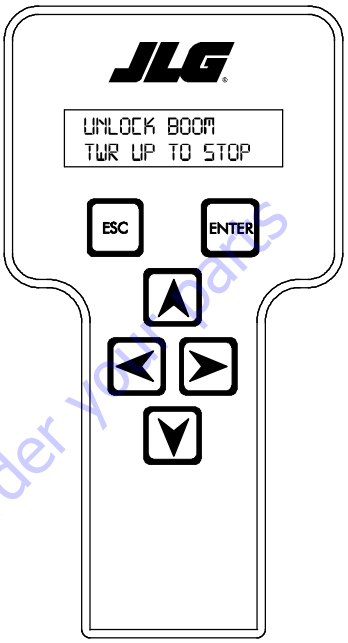

**13.** Activate Jib Swing until the jib is centered.

***NOTE:*** *Jib Swing will cut out when the system detects the jib is in line.*

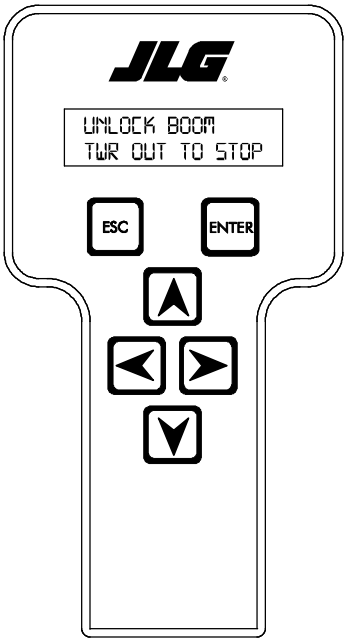
If no faults are present the screen will read:



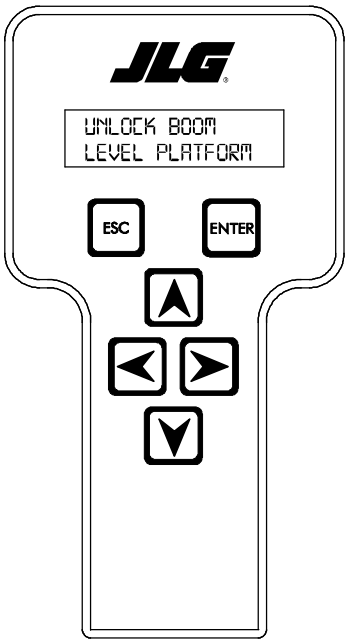

**14.** Activate Jib Lift to maximum elevation. Press ENTER (ENTER). The screen will read:




**15.** Activate Tower Lift Up till the boom stops. If no faults are present, the screen will read:



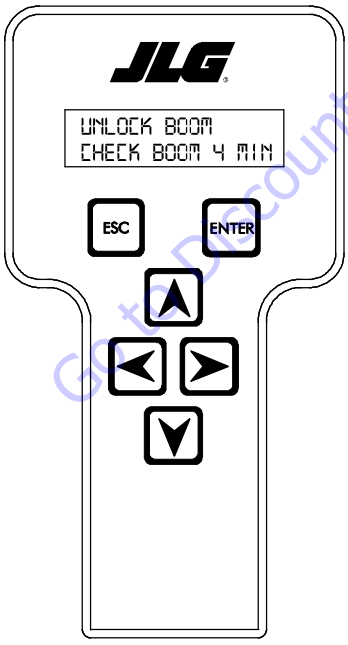
**16.** Activate Tower Extend till the boom stops. If no faults are present, the screen will read:



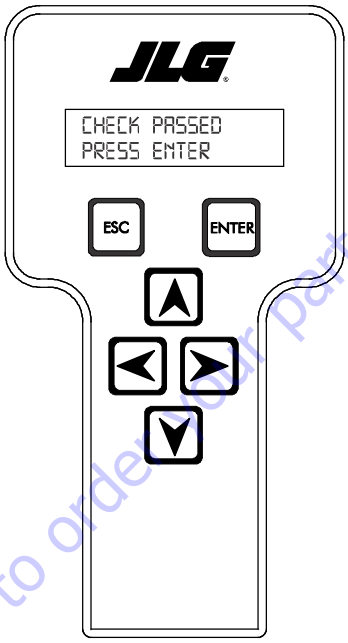

**17.** Activate Platform Level until the platform is in a leveled position.

***NOTE:*** *Platform Level will cut out when the system detects the platform is ± 5° of level.*

If no faults are present, the screen will read:

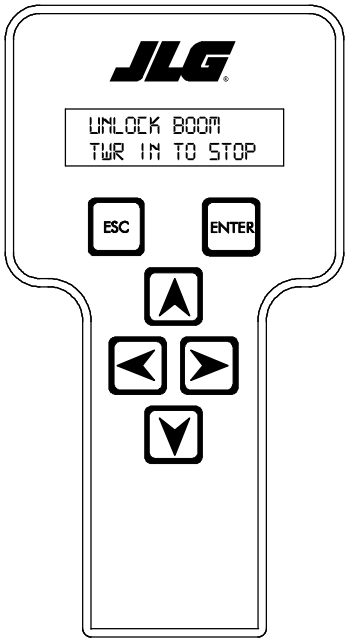



**18.** The Control System will check the boom for movement for 4 minutes. After 4 minutes, if functioning properly, the screen will read:

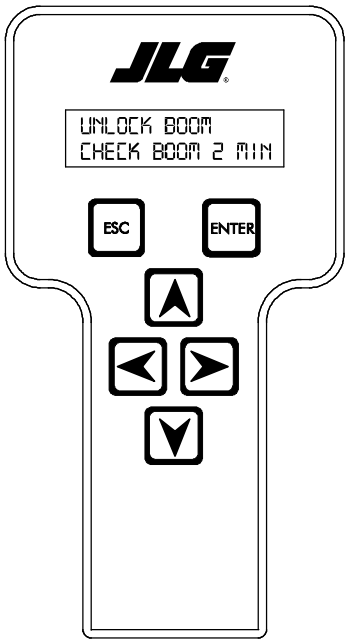



**19.** Press ENTER 

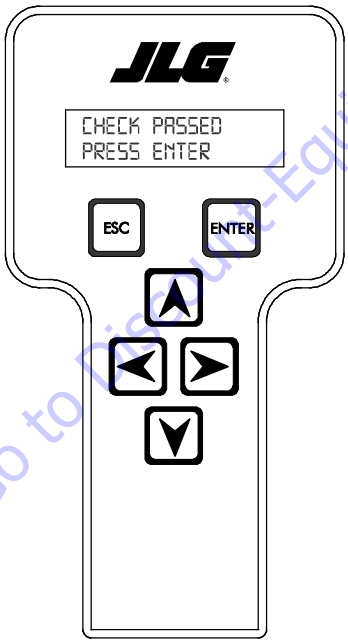
. The screen will read:



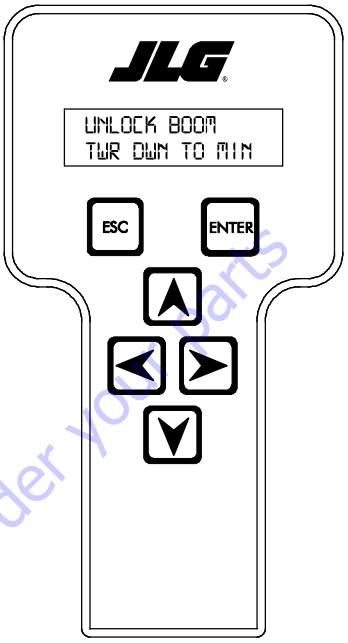
**20.** Activate Tower Retract till the boom stops. If no faults are present, the screen will read:



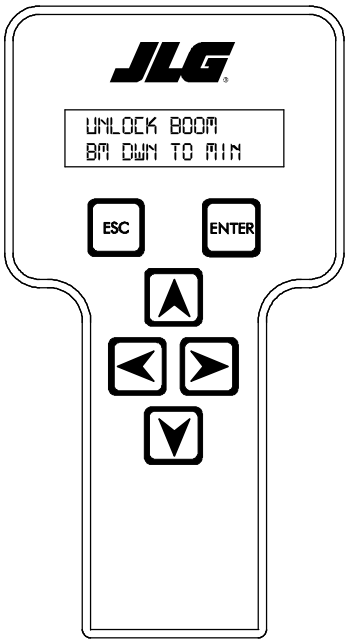

**21.** The Control System will check the boom for movement for 2 minutes. After 2 minutes, if functioning properly, the screen will read:




**22.** Press ENTER (ENTER). The screen will read:



**23.** Activate Tower Lower to minimum elevation. Press ENTER (ENTER). The screen will read:




**24.** Activate Main Boom Lower to minimum elevation. Press ENTER (ENTER). The screen will read: